Form PTO-1390 (REV 10-95) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371	2920-012194
	U S APPLICATION NO (If known, see 37 CFR 1 5) 10/019984

INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	PRIORITY DATES CLAIMED
PCT/AU00/00808	05.07.00 (July 05, 2000)	06.07.99 (July 06, 1999)

TITLE OF INVENTION

A PLECTRUM FOR A STRING INSTRUMENT, A TRANSMITTER/RECEIVER ARRANGEMENT AND A SIGNAL PROCESSING APPARATUS

APPLICANT(S) FOR DO/EO/US

Steve CHICK

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U S C 371

2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U S C 371

3. ☒ This express request to begin national examination procedures (35 U S C 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S C. 371(b) and PCT Articles 22 and 39(1).

4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. ☒ A copy of the International Application as filed (35 U.S.C 371(c)(2))
   - a ☐ is transmitted herewith (required only if not transmitted by the International Bureau)
   - b ☒ has been transmitted by the International Bureau
   - c ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).

6. ☐ A translation of the International Application into English (35 U S C 371(c)(2)).

7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U S C 371(c)(3))
   - a ☐ are transmitted herewith (required only if not transmitted by the International Bureau)
   - b ☐ have been transmitted by the International Bureau
   - c ☐ have not been made, however, the time limit for making such amendments has NOT expired
   - d ☒ have not been made and will not be made

8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U S C 371(c)(3))

9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4))

10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U S C 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1 97 and 1 98

12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3 28 and 3 31 is included

13. ☒ A FIRST preliminary amendment
    ☐ A SECOND or SUBSEQUENT preliminary amendment

14. ☐ A substitute specification

15. ☐ A change of power of attorney and/or address letter

16. ☒ Other items or information
    a. WO 01/03107-Front Page with Abstract, Specification, Claims, Drawings and Search Report (49 pp.)
    b. International Preliminary Examination Report and Annex (10 pp.)

U.S APPLICATION NO (If known, see 37 CFR 1 5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/019984	PCT/AU00/00808	2920-012194

17. ☒ The following fees are submitted:

		CALCULATIONS PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)):		
Search Report has been prepared by the EPO or JPO	$890.00	
International preliminary examination fee paid to USPTO (37 CFR 1 482)	$710.00	
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1 445(a)(2))	$740.00	
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1 445(a)(2)) paid to USPTO	$1,040.00	
International preliminary examination fee paid to USPTO (37 CFR 1 482) and all claims satisfied provisions of PCT Article 33(2)-(4).	$100.00	

ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 1,040.00	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☒ 30 months from the earliest claimed priority date (37 CFR 1 492(e))	$ 130.00	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	38 - 20	18	X $18.00	$ 324.00	
Independent claims	5 - 3 =	2	X $84.00	$ 168.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $280.00	$ 0.00	
TOTAL OF ABOVE CALCULATIONS =				$ 1,662.00	
Reduction of 1/2 for filing by small entity, if applicable The above applicant is entitled to claim Small Entity Status in the United States				$ 831.00	
SUBTOTAL =				$ 831.00	
Processing fee of $130.00 for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1 492(f)). +				$ 0.00	
TOTAL NATIONAL FEE =				$ 831.00	
Fee for recording the enclosed assignment (37 CFR 1 21(h)) The assignment must be accompanied by an appropriate cover sheet (37 CFR 3 28, 3 31) $40.00 per property +				$ 0.00	
TOTAL FEES ENCLOSED =				$ 831.00	
				Amount to be: refunded	$
				charged	$

a. ☒ A check in the amount of $ 831.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No _____ in the amount of $ _____ to cover the above fees.
A duplicate copy of this sheet is enclosed

c. ☒ The Assistant Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No 23-0650 A duplicate copy of this sheet is enclosed

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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PATENT APPLICATION/PCT
Attorney's Docket No. 2920-012194

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	:	
Steve CHICK	:	**A PLECTRUM FOR A STRING INSTRUMENT, A TRANSMITTER/RECEIVER ARRANGEMENT AND A SIGNAL PROCESSING APPARATUS**
International Application No. PCT/AU00/00808	:	
International Filing Date 05 July 2000	:	
Priority Date Claimed 06 July 1999	:	
Serial No. Not Yet Assigned	:	
Filed Concurrently Herewith	:	

Pittsburgh, Pennsylvania
January 4, 2002

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington DC 20231

Sir:

Prior to initial examination, please amend the above-identified patent application as follows:

IN THE CLAIMS:

Please cancel original claims 1-43 and cancel amended claim 30 and rewrite them as new claims 44-81 as follows:

44. A plectrum for a string instrument having a plurality of conductive strings, said plectrum including:

a non-conductive body defining a gripping portion and a plucking portion; and

a conductive tip protruding just beyond an edge of said plucking portion, an outer surface of said tip being sized so as to fleetingly contact a string of said instrument when said string is plucked by said plucking portion, said tip further being capable of operative association with electronic monitoring circuitry adapted to provide a triggering signal each time the tip contacts any one of said strings.

45. The plectrum according to claim 44, wherein said tip is electrically connected to a first wire embedded within said body, said first wire being, in turn, electrically connected to a second wire external of said body and extending from a point on said body remote of said plucking portion.

46. The plectrum according to claim 44, wherein said tip protrudes from an outer edge of said plucking portion by no more than 1 mm.

47. The plectrum according to claim 44, wherein a perimeter length of said tip is no longer than 8 mm.

48. The plectrum according to claim 44, wherein a width of said tip is less than a width of said body.

49. The plectrum according to claim 45, wherein said body is generally a triangular shape, a region adjacent a first apex of said triangular shape defining said plucking portion, and a region adjacent the other two apexes defining said gripping portion, said tip being disposed at said first apex.

50. The plectrum according to claim 49, wherein said second wire extends from, or adjacent to, one of said other apexes.

51. The plectrum according to claim 44, wherein an outer edge of said tip is shaped to generally correspond to a shape of said outer edge of said plucking region from which it extends.

52. The plectrum according to claim 44, wherein said electronic monitoring circuitry is adapted to detect the initial contact between the tip and the string and to use said initial contact as the basis for the triggering signal.

53. A transmitter/receiver arrangement adapted for use with a plectrum, said arrangement including a transmitter having a signal generator electrically connectable to said tip such that, when said tip fleetingly connects with said string during plucking, the transmitter produces a signal which is detectable by receiver circuitry, said receiver circuitry being operatively associated with said electronic monitoring circuitry so as to provide said triggering signal.

54. The transmitter/receiver arrangement according to claim 53, wherein said transmitter is mountable to a person playing the instrument, said transmitter being electrically connectable to said plectrum by said second wire.

55. The transmitter/receiver arrangement according to claim 54, wherein said transmitter is disposed upon, or housed within, a strap mountable to a wrist of said person.

56. The transmitter/receiver arrangement according to claim 55, wherein said strap includes means to house or mount a battery to power said radio frequency signal generator.

57. The transmitter/receiver arrangement according to claim 53, wherein said string is electrically connected to an instrument-ground, which is, in turn, electrically connected to said receiver.

58. The transmitter/receiver arrangement according to claim 53, wherein said signal generator is a radio frequency signal generator capable of producing a waveform at a carrier frequency, and said receiver circuitry is adapted to compare the carrier frequency with a local oscillator signal so as to only acknowledge a contact between the tip and the string once an intermediate frequency, which is a difference between the carrier frequency and the local oscillator frequency, is detected by the receiver, thereby reducing the likelihood of false triggering due to outside interference from radio frequency noise.

59. The transmitter/receiver arrangement according to claim 58, wherein both said carrier frequency and a frequency of said local oscillator signal are within the range 100 KHz to 30 MHz.

60. The transmitter/receiver arrangement according to claim 58, wherein said instrument-ground is electrically connected to a receiver-ground, said connection effectively forming an electrical short between said grounds at audio frequencies, and a first tuned receiver between said grounds which is broadly tuned at said carrier frequency.

61. The transmitter/receiver arrangement according to claim 59, wherein said connection is an inductor and a capacitor wired in parallel between the instrument-ground and the receiver-ground.

62. The transmitter/receiver arrangement according to claim 60, wherein, after passing through said connection, the radio frequency signal is amplified.

63. The transmitter/receiver arrangement according to claim 60, wherein said receiver circuitry includes a selective band pass filter tuned at the intermediate frequency.

64. The transmitter/receiver arrangement according to claim 62, wherein said local oscillator signal is derived from a clock circuit of a microprocessor or from a frequency crystal.

65. The transmitter/receiver arrangement according to claim 53, wherein said electronic monitoring circuitry includes a detector circuit adapted to output an envelope of the intermediate frequency component of the radio frequency signal, said envelope having brief pulses substantially corresponding to the period of time for which the plectrum tip is in contact with the string.

66. The transmitter/receiver arrangement according to claim 65, wherein said brief pulses are time-stretched so as to provide a modified signal having time-stretched pulses which would not be missed by a microprocessor.

67. The transmitter/receiver arrangement according to claim 66, wherein said electronic monitoring circuitry includes a microprocessor adapted to receive said modified signal and perform an analog-to-digital conversion thereto.

68. The transmitter/receiver arrangement according to claim 67, wherein said microprocessor is further adapted to detect positive transients in said modified signal and to generate said triggering signal by correlating each of said positive transients with an initial contact of the plectrum tip with the string.

69. The transmitter/receiver arrangement according to claim 53, wherein said receiver circuitry is adapted to store and output a value corresponding to a maximum amplitude of an audio signal from said instrument each time the plectrum contacts the string.

70. The transmitter/receiver arrangement according to claim 69, wherein said electronic monitoring circuitry includes a microprocessor adapted to measure the stored value and to output a digital value corresponding to the amplitude.

71. A transmitter adapted for use with a plectrum as defined in claim 44, said transmitter having a radio frequency signal generator electrically connectable to said tip such that, when said tip fleetingly connects with said string during plucking, the tip injects a radio frequency signal into the string.

72. A receiver adapted for use with the transmitter as defined in claim 71, including receiver circuitry being tuned to said radio frequency so as to detect the radio frequency signal injected into the string, the receiver being operatively associated with said electronic monitoring circuitry so as to provide said triggering signal.

73. A signal processing apparatus in combination with a string instrument being plucked by the plectrum defined in claim 44, wherein said signal processing apparatus is adapted to process an audio signal derived from said string instrument, said apparatus including:

a first input to receive said audio signal;

a second input to receive a triggering signal which includes a plurality of triggering pulses, each indicative of a plucking of any of said strings by said plectrum tip;

signal processing circuitry adapted to perform a plurality of different processes, each process modifying the audio signal, said circuitry being electrically connected to said first and second inputs, and wherein said signal processing circuitry is adapted to vary the particular process used to modify the audio signal according to a predefined relationship with said triggering signal; and

an output electrically connected to said signal processing circuitry for outputting a modified audio signal.

74. The signal processing apparatus according to claim 73, wherein said predefined relationship is such that the process is varied each time an integral number of triggering pulses are received by the signal processing circuitry.

75. The signal processing apparatus according to claim 74, wherein said integral number is one.

76. The signal processing apparatus according to claim 73, wherein, during a transition from a first process to a second process, the first process is progressively faded out and the second process is simultaneously progressively faded in.

77. The signal processing apparatus according to claim 76, wherein said transition commences upon receipt of a triggering pulse such that each transition is initiated substantially at each moment the tip first contacts the plectrum during plucking.

78. The signal processing apparatus according to claim 73, wherein at least one of the operative characteristics of one or more of said processes is variable dependent upon a maximum amplitude of the audio signal each time the plectrum contacts a string.

79. The signal processing apparatus according to claim 73, wherein said plectrum communicates with said signal processing apparatus via a transmitter and/or receiver arrangement, said arrangement including a transmitter having a signal generator electrically connectable to said tip such that, when said tip fleetingly connects with said string during plucking, the transmitter produces a signal which is detectable by receiver circuitry, said receiver circuitry being operatively associated with said electronic monitoring circuitry so as to provide said triggering signal.

80. The signal processing apparatus according to claim 78, further comprising a transmitter/receiver arrangement,

including a transmitter having a signal generator electrically connectable to said tip such that, when said tip fleetingly connects with said string during plucking, the transmitter produces a signal which is detectable by receiver circuitry, said receiver circuitry being operatively associated with said electronic monitoring circuitry so as to provide said triggering signal;

wherein said receiver circuitry is adapted to store and output a value corresponding to a maximum amplitude of an audio signal from said instrument each time the plectrum contacts the string; and

said electronic monitoring circuitry includes a microprocessor adapted to measure the stored value and to output a digital value corresponding to the amplitude,

wherein the signal processing apparatus includes a third input to receive said digital value, said third input being adapted to feed said value to the signal processing circuitry.

81. The signal processing apparatus according to claim 80, wherein the second and third inputs comprise a single input which is adapted to receive and decode an information stream having information relating to both the triggering and the maximum amplitude.

IN THE ABSTRACT:

After the claims, please insert a page containing the Abstract Of The Disclosure, which is attached hereto as a separately typed page.

REMARKS

Original claims 1-43 and Amended claim 30 have been canceled and rewritten as new claims 44-81.

An Abstract Of The Disclosure has been added as a separately typed page to be inserted after the claims.

Examination and allowance of claims 45-81 are respectfully requested.

Respectfully submitted,

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By 

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A PLECTRUM FOR A STRING INSTRUMENT, A TRANSMITTER/RECEIVER ARRANGEMENT AND A SIGNAL PROCESSING APPARATUS

ABSTRACT OF THE DISCLOSURE

A plectrum for a stringed musical instrument having a plurality of conductive strings is provided with a non-conductive body and a conductive tip. The conductive tip is sized so as to fleetingly contact a string when the string is plucked with a plectrum. The tip is electrically connected to a monitoring circuitry which provides a triggering signal each time the tip contacts any of the strings. A transmitter and receiver arrangement is provided to monitor the contact of the tip with the strings and generate the triggering signal. The triggering signal is in turn received by a signal processing apparatus which modifies the audio signal output from the stringed musical instrument under the control of the triggering signal.

TITLE: A Plectrum for a String Instrument, A Transmitter/Receiver Arrangement and a Signal Processing Apparatus

FIELD OF THE INVENTION:

The present invention relates to string instruments having a plurality of conductive strings, for example electric guitars. In particular, the present invention relates to a plectrum for use with such string instruments, a transmitter/receiver arrangement adapted for use with the plectrum and a signal processing apparatus also adapted for use with the plectrum.

The invention has been developed primarily for use in digital processing of the audio output from a string instrument and will be described hereinafter with reference to this application. However, it will be appreciated that the invention is not limited to this particular field of use. For example, the triggering signal derived from the present invention can also be used to drive effects other than audio effects, for example lighting effects being synchronised with music played upon the string instrument.

BACKGROUND TO THE INVENTION:

Known techniques for processing an audio signal derived from string instruments are limited by the difficulty of providing an accurate triggering signal to enable event-driven signal processing techniques. Accordingly, most signal processing techniques currently used in real-time with string instruments are continuous in the sense that a signal processing process is not stopped and started on an event basis. Typical audio effect processes such as echo, reverberation, phasing, panning, chorus and flanging are usually continuous in nature since the effect is applied to the audio signal continuously for as long as the effect is desired.

An attempt to provide a triggering signal to enable more sophisticated signal processing is described in US Patent No. 4,235,144. This prior art document discloses a

conductive pick connected to a contact sensor which senses conductive contact between the strings of the guitar and the conductive pick. In this arrangement, breaking contact between the pick and the string initiates a special musical effect.

It has been appreciated by the inventor of the present invention however that this prior art arrangement suffers numerous technical defects to the extent that it cannot be successfully employed to provide a triggering signal reliable enough to enable sophisticated event-driven signal processing. In particular, the inventor of the present invention has discovered that the conductive contact between the string and the prior art conductive pick can be subject to numerous imperfections leading to false triggering. This can be exacerbated by the habit of some string instrument players of resting their pick on the string before actually plucking the string. As the prior art arrangement triggers from the moment when conductive contact between the pick and the string is broken, the imperfect conductive connection can result in false triggering. Other factors leading to imperfect triggering by the prior art arrangement of US Patent No. 4,235,144 include: a string and/or the pick may be tarnished, thereby inhibiting stable conductive contact; the pressure of the pick on the string may not be constant due to the player touching the pick against the string lightly; and larger gauge strings in particular can be vibrating quite vigorously towards and away from the pick, thereby initiating and breaking conductive contact prior to plucking of the string. Whilst this imperfect triggering may suffice for the relatively simple effects outlined in the abovementioned US patent, it has been found by the inventor of the present application not to suffice for slightly more sophisticated triggering such as MIDI triggering, Control Voltage and Gate triggering, in other words, the type of triggering required for the signal processing provided by modern synthesizers.

OBJECT OF THE INVENTION:

It is an object of the present invention to overcome or ameliorate at least one of the disadvantages of the prior art, or to provide a useful alternative.

SUMMARY OF THE INVENTION:

According to a first aspect of the invention there is provided a plectrum for a string instrument having a plurality of conductive strings, said plectrum including:

a non-conductive body defining a gripping portion and a plucking portion; and

a conductive tip protruding just beyond an edge of said plucking portion, an outer surface of said tip being sized so as to fleetingly contact a string of said instrument when said string is plucked by said plucking portion, said tip further being capable of operative association with electronic monitoring circuitry adapted to provide a triggering signal each time the tip contacts any one of said strings.

Preferably the tip is electrically connected to a first wire embedded within the body which is, in turn, electrically connected to a second wire external of the body and extending from a point on the body remote of the plucking portion.

In the preferred embodiment the tip protrudes from an outer edge of the plucking portion by no more than 1mm and the perimeter length of the tip is no greater than 8mm.

According to a second aspect of the invention there is provided a transmitter/receiver arrangement adapted for use with a plectrum as described above, said arrangement including a transmitter having a signal generator electrically connectable to said tip such that, when said tip fleetingly connects with said string during plucking, the transmitter produces a signal which is detectable by receiver circuitry, said receiver circuitry being operatively associated with said electronic monitoring circuitry so as to provide said triggering signal.

Preferably the transmitter is mountable to a person playing the instrument, for example by means of a strap mounted to the wrist of the person. The transmitter is preferably electrically connectable to the plectrum by the second wire.

According to a third aspect of the invention there is provided a transmitter adapted for use with a plectrum as described above, said transmitter having a radio frequency signal generator electrically connectable to said tip such that, when said tip fleetingly connects with said string during plucking, the tip injects a radio frequency signal into the string.

According to a fourth aspect of the invention there is provided a receiver adapted for use with the transmitter as described above including receiver circuitry being tuned to said radio frequency so as to detect the radio frequency signal injected into the string, the receiver being operatively associated with said electronic monitoring circuitry so as to provide said triggering signal.

According to another aspect of the invention there is provided a signal processing apparatus adapted to process an audio signal derived from a string instrument having a plurality of conductive strings being plucked by the plectrum described above, said apparatus including:

a first input to receive said audio signal;

a second input to receive a triggering signal which includes a plurality of triggering pulses, each indicative of a plucking of any of said strings by said plectrum tip;

signal processing circuitry adapted to perform a plurality of different processes, each process modifying the audio signal, said circuitry being electrically connected to said first and second inputs, and wherein said signal processing circuitry is adapted to vary the particular process used to modify the audio signal according to a predefined relationship with said triggering signal; and

an output electrically connected to said signal processing circuitry for outputting a modified audio signal.

In one preferred embodiment the predefined relationship is such that the process is varied each time an integral number of triggering pulses are received. For example, this integral number may be 1, in other words the process applied to the audio signal is varied each time a triggering pulse is received.

BRIEF DESCRIPTION OF THE DRAWINGS:

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a cross-sectional view of a plectrum according to the invention taken through Line 1-1 of Fig. 3;

Fig. 2 is a plan view of the plectrum shown in Fig. 1;

Fig. 2a is an exploded view of the tip shown within the dotted region of Fig. 2;

Fig. 3 is a side view of the plectrum shown in Fig. 1;

Fig. 4 is a plan view of the plectrum shown in Fig. 1, along with a string of an instrument;

Fig. 5 is a progressive view of a plectrum according to the present invention plucking a string on an instrument, along a pulse arising from said plucking action;

Fig. 6 is a schematic view of a transmitter/receiver arrangement according to the present invention and its relationship to a string instrument;

Fig. 7 is a plan view of a transmitter mounted to the wrist of a user, said transmitter being electrically connected to a plectrum according to the invention;

Fig. 8 is a part-perspective, part-schematic view of a receiver according to the present invention, the receiver being electrically connected to a string instrument;

Fig. 9 is a circuit diagram showing circuitry included in a transmitter according to the present invention;

Fig. 10 is a circuit diagram showing circuitry included in a receiver according to the present invention;

Figs. 11 to 15 inclusive are waveform diagrams showing various signals associated with the transmitter/receiver arrangement of the present invention;

Fig. 16 is a schematic diagram illustrating the transition between various events in a signal processing apparatus according to the invention; and

Fig. 17 is a schematic view of a signal processing apparatus according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS:

Referring to the drawings, the plectrum 4 shown in Figs. 1 to 5 includes a non-conductive body 5 having a gripping portion 6 and a plucking portion 7. The body 5 is constructed of a plastics material in the preferred embodiment. A conductive tip 8 protrudes just beyond an edge 9 of the plucking portion 7. The outer surface of the tip 8 is sized so as to fleetingly contact a string 10 of the instrument 11 as the string 10 is plucked by the plucking portion 7. This is best shown in the progressive plucking action illustrated in Fig. 5. In particular, contact between the tip 8 and the string 10 occurs at step D of Fig. 5. The tip 8 is capable of operative association with electronic monitoring circuitry 12, an embodiment of which is shown in Fig. 10. The details of the operative association between the tip 8 and the electronic monitoring circuitry 12 will be described in more detail later in this document. The electronic monitoring circuitry 12 is adapted to provide a triggering signal shown as signal G in Fig. 15 each time the tip 8 contacts any of the strings 10 of the instrument 11.

This inventive arrangement has been found to provide far more reliable triggering than that provided by the prior art. Additionally, because the tip 8 only contacts the string 10 during the instant of plucking, it is possible for the electronic monitoring circuitry 12 to monitor for any moment that conductive contact between the tip 8 and the wire 10 is made, rather than monitoring for the moment when conductive contact is broken, as in the prior art.

The geometry of the non-conductive body 5 and the barely exposed tip 8 is such that a player can rest the plectrum against a string, as shown in views B and C of Fig. 5 prior to plucking without the tip 8 contacting the string 10, and therefore without causing any false triggering. Additionally, as the electronic monitoring circuitry 12 of the preferred embodiment monitors for the instant that conductive contact is made, rather than broken, it is possible for the arrangement of the present invention to provide a triggering signal wherein each triggering pulse is initiated an instantaneous moment before a string 10 is actually plucked. This advantageously effectively provides a lead time which can be offset against any lag time that may exist in the audio signal processing apparatus to help ensure that the audio signal processing apparatus is in a required state prior to, or at the moment of, receiving the audio input resulting from the plucking of the string.

The tip 8 is electrically connected to a first wire 13 which may be embedded within the body 5. In other embodiments (not illustrated), the tip 8 is an integral part of the wire 13. The first wire 13 is, in turn, electrically connected to a second wire 14 external of the body 5. The second wire 14 extends from a point 15 of the body 5 remote of the plucking portion 7.

In one embodiment the first and second wires 13 and 14 are formed from a pre-shrunk polyester (not illustrated) upon which silver conductive ink is screen printed to provide a conductive surface. This advantageously provides a strong conductor which is sufficiently thin to be embedded within the body 5, or applied thereto as a surface coating.

Additionally, the pre-shrunk polyester can be manufactured with a width which can be attached to the plectrum 4 such that the width is aligned with the body 5. This provides ergonomic advantages by contributing to freedom of movement of the plectrum. The width is preferably between 2mm and 8mm, and in the preferred embodiment is approximately 3.5mm.

The tip 8 preferably protrudes from the outer edge 9 of the plucking portion 7 by no more than 1mm. In the preferred embodiment, the distance by which the tip 8 protrudes is 0.5mm. This dimension can be best appreciated with reference to Fig. 3 and in particular to the perpendicular distance separating lines 16 marked thereon. In the preferred embodiment the perimeter length of the tip 8 is no greater than 8mm and the dimension used in the preferred embodiment is 2mm. This dimension can be best appreciated from Fig. 2a, and in particular from the distance separating lines 17 marked thereon. The width of the tip 8 is preferably no greater than the width of the pick and in the preferred embodiment is 0.5mm. This can be best seen with reference to Fig. 3 and in particular to the perpendicular distance separating lines 18 marked thereon. This dimension is less than the corresponding width of the body 5. An outer edge 22 of the tip 8 is shaped to generally correspond to the shape of the outer edge of the plucking region 7 from which the tip 8 extends.

As best shown in Fig. 2, the body 5 of the plectrum 4 is generally a triangular shape. The region adjacent first apex 19 defines the plucking portion 7 and the tip 8 is disposed at the first apex 19. The second wire 14 extends from, or adjacent to, one of the other apexes, in this case, apex 20. In other embodiments, the second wire 14 extends from other regions of the body 5 of the plectrum 4. The region adjacent apexes 20 and 21 defines the gripping portion 6.

The electronic monitoring circuitry 12 is adapted to detect the initiation of conductive contact between the tip 8 and the string 10 and to use said contact as the

basis for the triggering signal. The switch which is effectively formed by the plectrum 4 and the string 10 is shown in an open state in figure 4.

Fig. 6 depicts a schematic representation of the transmitter 23, a receiver 24 and a preferred embodiment of a transmitter/receiver arrangement whereby said transmitter 23 communicates to said receiver 24. The transmitter 23 includes a signal generator 25 which is electrically connectable to the tip 8. In one embodiment, the tip 8 is connected to a radio frequency signal generator 25 via the first and second wires, the second wire terminating in a plug which is mateable with a socket provided upon the transmitter 23. When the tip 8 fleetingly connects with the string 10 during plucking, as shown in Fig. 5, the tip 8 injects a radio frequency signal shown as signal A in Fig. 11 into the string 10. The radio frequency signal (signal A) is detectable by receiver circuitry 26 which is tuned to the signal. The receiver 24 is operatively associated with electronic monitoring circuitry 12 so as to provide the triggering signal (signal G).

In another embodiment (not illustrated), the electrical connection between the tip 8 and the transmitter 23 is achieved by means of capacitive coupling. It will be appreciated by those skilled in the art that other methods of electrical connection may also be used.

In the illustrated preferred embodiment the transmitter 23 is mountable to a person 27 playing the instrument 11. In particular, the transmitter 23 is disposed upon, or housed within, a strap 28 mountable to a wrist of the person 27. The strap of the preferred embodiment is held in place by hook and eye fasteners (also known as "velcro"), although clearly other fastening means may be employed. The strap 28 includes means to house or mount a battery (not illustrated) to power the radio frequency signal generator 25. This allows the player 27 of the instrument 11 greater freedom of movement as compared to having the plectrum 4 hard wired to circuitry win the receiver which would require a long cable from the plectrum to the receiver.

As illustrated in Fig. 9, the transmitter circuitry of the preferred embodiment makes radio frequency grounding connections labelled RGND or +3V. This may be achieved by allowing one of the terminal connections of the battery to make direct connection with the skin of a user. Such a radio frequency ground connection has been found by the inventor to provide a significantly stronger signal, if such is desired.

The strings 10 of the instrument 11 are electrically connected to an instrument-ground 29, which is, in turn, electrically connected to the receiver 24, and in particular to the receiver circuitry 26. The instrument-ground 29 is normally included as a part of the audio cable.

The radio frequency generator 25 is capable of producing a signal A as shown in Fig. 11. This signal is a waveform at a carrier frequency which preferably lies within the range of 100KHz to 30MHz, and in the preferred embodiment is 3.545MHz.

As best shown in Fig. 6, the instrument-ground 29 is electrically connected to the receiver-ground 30, the connection 31 effectively forming an electrical short between the grounds 29 and 30 at audio frequencies such as those generated by the instrument 11, however the connection 31 also effectively forms a first tuned receiver between the grounds 29 and 30, the tuned receiver being broadly tuned at the carrier frequency. The connection 31 is an inductor (labelled L1 in Fig. 6 and labelled L11 in Fig. 10) and a capacitor (labelled C1 in Fig. 6 and C26 in Fig. 10) wired in parallel between the instrument-ground 29 and the receiver-ground 30. The 3.545MHz radio frequency that is coupled into the resonate circuit 31 appears as a voltage at connection 29, this voltage is illustrated in Fig. 12 signal B. Signal B is coupled through the capacitor C27 into the amplifier circuitry 28 which is comprised of Q1, R34, R35, R36, R37 and C23. This 3.545MHz amplified signal is then coupled through C22 onto the base of transistor Q3 which forms a non-linear mixer along with R42, R38, R39, and R43, circuitry 34. A 4.00MHz local oscillator signal is generated from circuitry 33. This circuitry comprises U8,

C57, C58, R73 and X5. Such an arrangement allows the local oscillator frequency to be easily changed by using a different frequency crystal X5, along with a corresponding change to the frequency of the transmitter. Such a change may become necessary if two identical preferred embodiments are operating at close quarters and interfering with each other. The output (U5 pin 2) is coupled onto the emitter of Q3 through the capacitor C34. The resulting Signal C as appears on the collector of Q3 has a frequency component that is equal to the difference between the 3.545MHz carrier frequency and the 4.00MHz local oscillator. This difference is known as the intermediate frequency and in the preferred embodiment is a waveform having a 455KHz component as shown in Fig. 13. The amplitude of the 455KHz frequency component is directly proportional to the amplitude of the 3.545MHz carrier radio frequency. The band pass filter as described next selectively passes only the 455KHz frequency so in effect the circuitry has selectivity for the frequency of 3.545MHz. This helps in the rejection of broad spectrum noise which could potentially interfere with the operation of the device. This technique is known as a superheterodyne receiver. This gives Signal C as shown in Fig. 13. Signal C is then passed through a selective band pass filter 35 tuned at the intermediate frequency. In the preferred embodiment, the selective band pass filter 35 is comprised of a ceramic resonator labelled X2 in Fig. 10. The output of the selective band pass filter 35 is signal D as shown in Fig. 14. Signal D is present in the electronic monitoring circuit only when the tip 8 of the plectrum 4 is in contact with the string 10. This is shown in Fig. 15 where intermittent bursts of signal D are shown.

The signal is then amplified by Q4 as shown in Fig. 10. The degree of amplification is varied by potentiometer VR2. This allows the user to adjust the signal strength, which affects the sensitivity of the system to outside interference. If the gain is too low the system may miss triggers, however if it is too high false triggers may be caused by outside electromagnetic interference.

The signal is then passed through a detector circuit 36 which is made up of Q5, R50 & C42 as also shown in Fig. 10. The output of Q5 is the envelope of the intermediate frequency component which is proportional to the radio frequency signal. This is shown as signal E in Fig. 15. The envelope has brief pulses 37 which substantially correspond to the period of time for which the plectrum tip 8 is in contact with the string 10. This signal is then AC coupled and amplified by U5B as shown in Fig. 10. The brief pulses 37 are then time-stretched so as to provide a modified signal (signal F shown in Fig. 15) having time-stretched pulses 38 which, because of their longer duration, are not missed by the microprocessor to which the signal is subsequently fed. The time-stretching of the pulses 37 is performed by D15, C45, R54 and R57 as shown in Fig. 10.

The electronic monitoring circuitry 12 includes a microprocessor 39 adapted to receive said modified signal (signal F) and to perform an analogue-to-digital conversion thereto using U2 so as to produce a digital representation of signal F. The microprocessor 39 is further adapted to detect positive transients 40 in the digital version of the signal and to generate a triggering signal (signal G) by correlating each of the positive transients 40 with an initial contact of the plectrum tip 8 with the string 10. In other words, each time the plectrum tip 8 initially makes conductive contact with the string 10, instantaneously before the moment of plucking, the electronic monitoring circuitry is adapted to output a triggering signal responsive to said contact. The triggering signal (signal G) provided by one preferred embodiment of the invention is of the MIDI (Musical Instrument Digital Interface) type. An alternative embodiment outputs a triggering signal consisting of a control voltage and a gate signal (this alternative triggering signal is not illustrated). The triggering signal is fed from the receiver 24 via triggering cable 41 as shown in Fig. 8.

Put simply, when a transient 40 of sufficient amplitude is detected, a pick event is deemed to have happened and the associated controlled signals are then generated to provide a triggering signal.

The audio signal (not illustrated) generated by the instrument 11 is applied to amplifier U3C via resistor R13 as shown in Fig. 10. This circuitry 50 is adapted to store maximum amplitudes of the audio signal from the instrument 11. In other words, each time a string 10 of the instrument 11 is plucked, the receiver circuitry stores a maximum amplitude of the resulting audio signal. The circuitry of U3B, U3D, D4, D7 and C15 (as indicated on Fig. 10) holds said maximum amplitude. The electronic monitoring circuitry 12 includes a microprocessor 39 (which may be the same microprocessor mentioned previously, or may be a separate microprocessor) which is adapted to measure the stored amplitude and to output a value corresponding to the amplitude. In some embodiments this value is digital and in other embodiments it is analogue. The value is effectively an output corresponding to the force with which the string 10 is plucked. This information can be transmitted to an audio effects system so that effects can respond to the intensity with which a string 10 is plucked. In some embodiments, the electronic monitoring circuitry 12 and the receiver circuitry 50 are adapted to measure and record the maximum amplitude of the audio signal each time the tip 8 contacts a string 10. In other embodiments, circuitry 12 and 50 is adapted to measure the maximum amplitudes occurring during predefined time intervals.

With reference to Fig. 17, the signal processing apparatus 42 processes the audio signal derived from the string instrument 11. In some preferred embodiments all signal processing is performed digitally, in other preferred embodiments the signal processing may be exclusively analogue, or a combination of digital and analogue. The signal processing apparatus 42 is adapted to function in conjunction with the plectrum of the present invention. The apparatus 42 includes a first input 43 to receive the audio

signal from the string instrument 11. The second input 44 receives the triggering signal (signal G) which includes a plurality of triggering pulses, each indicative of a plucking of any of the strings 10 by the plectrum tip 8. The apparatus 42 houses signal processing circuitry 45 which is adapted to perform a plurality of different processes, each process modifying the audio signal. For example, some of the processes may be relatively straight forward modifications to provide effects such as echo, reverberation, phasing, panning, chorus and flanging. However more sophisticated and elaborate processes may be provided by altering one more parameter values and/or one or more effects algorithms which are, in turn, used by the signal processing circuitry 45 to modify the audio signal. The signal processing circuitry 45 is electrically connected via wires 46 to the first and second inputs respectively, 43 and 44. The signal processing circuitry 45 is adapted to vary the particular process used to modify the audio signal according to a predefined relationship with the triggering signal. In other words, the signal processing circuitry 45 has a number of different processes or "effects", which can be varied based upon the triggering signal. The apparatus 42 also includes an output 47 electrically connected to the digital signal processing circuitry 45 via wire 46 for outputting the modified audio signal (not illustrated).

The predefined relationship between the triggering signal and the varying of the particular process used to modify the audio signal can be adjusted as required. For example, in one embodiment, the particular process used to modify the audio signal is varied each time an integral number of triggering pulses are received. In another embodiment, the integral number is 1, meaning that the particular process used to modify the audio signal is varied each time a triggering pulse is received by the signal processing circuitry 45. This is shown schematically in figure 16. It would be appreciated by those skilled in the art, however, that other predefined relationships may be used, for example making a first variation to the particular process after a first number of triggering pulses

are received, followed by a second variation to the particular process after a second number of triggering pulses are received, and so on.

During the transition from a first process to a second process, the first process is progressively faded out and the second process is simultaneously progressively faded in. This transitional arrangement is illustrated in Fig. 16 where the horizontal axis represents time and the vertical axis represents the degree to which a particular process is used to modify the audio signal. At the time when a triggering pulse is received 48, the degree to which the first process 49 is applied to the audio signal begins to decrease and, simultaneously, the degree to which the second process 50 is applied to the audio signal is increased. This provides a smooth transition between processes. As can be seen in Fig. 16, the same fade-in, fade-out technique is used each time a subsequent variation of a process is made. The transition commences upon receipt of a triggering pulse such that each transition is initiated substantially at each moment the tip 8 first contacts the plectrum during plucking. As described above, triggering from the moment of initial contact (rather than the moment of which contact is broken as in the prior art) advantageously provides a brief lead-in time before the string 10 of the instrument 11 is actually plucked. This enables any delay that may be introduced by the signal processing circuitry 45 to be off-set against the "head start" provided by the triggering signal.

The preferred embodiment of the signal processing apparatus 42 includes provision for at least one of the operative characteristics of one or more of said processes to be variable dependent upon the maximum amplitude of the audio signal each time the plectrum 4 contacts a string 10. The signal processing apparatus 42 includes a third input 51 to receive a value indicative of a maximum amplitude of the audio signal from the microprocessor 39. The third input 51 is adapted to feed the value to the signal processing circuitry 35 via a wire 52. The operative characteristics of the processes which may be varied include factors such as the parameters and/or the algorithms used

to modify the audio signal. In some embodiments, the function of the second and third inputs, 44 and 51, is performed by a single input (not illustrated) which is adapted to receive and de-code an information stream having information relating to both the triggering and the maximum amplitude.

Although the invention has been described with reference to specific examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.

CLAIMS:

1. A plectrum for a string instrument having a plurality of conductive strings, said plectrum including:

a non-conductive body defining a gripping portion and a plucking portion; and

a conductive tip protruding just beyond an edge of said plucking portion, an outer surface of said tip being sized so as to fleetingly contact a string of said instrument when said string is plucked by said plucking portion, said tip further being capable of operative association with electronic monitoring circuitry adapted to provide a triggering signal each time the tip contacts any one of said strings.

2. A plectrum according to claim 1 wherein said tip is electrically connected to a first wire embedded within said body, said first wire being, in turn, electrically connected to a second wire external of said body and extending from a point on said body remote of said plucking portion.

3. A plectrum according to claim 1 or 2 wherein said tip protrudes from an outer edge of said plucking portion by no more than 1 mm.

4. A plectrum according to any one of the preceding claims wherein a perimeter length of said tip is no longer than 8 mm.

5. A plectrum according to any one of the preceding claims wherein a width of said tip is less than a width of said body.

6. A plectrum according to any one of the preceding claims wherein said body is generally a triangular shape, a region adjacent a first apex of said triangular shape defining said plucking portion, and a region adjacent the other two apexes defining said gripping portion, said tip being disposed at said first apex.

7. A plectrum according to claim 6 when depended from claim 2, wherein said second wire extends from, or adjacent to, one of said other apexes.

8. A plectrum according to any one of the preceding claims wherein an outer edge of said tip is shaped to generally correspond to a shape of said outer edge of said plucking region from which it extends.

9. A plectrum according to any of the preceding claims wherein said electronic monitoring circuitry is adapted to detect the initial contact between the tip and the string and to use said initial contact as the basis for the triggering signal.

10. A transmitter / receiver arrangement adapted for use with a plectrum as defined in any one of claims 1 to 9, said arrangement including a transmitter having a signal generator electrically connectable to said tip such that, when said tip fleetingly connects with said string during plucking, the transmitter produces a signal which is detectable by receiver circuitry, said receiver circuitry being operatively associated with said electronic monitoring circuitry so as to provide said triggering signal.

11. A transmitter / receiver arrangement according to claim 10 wherein said transmitter is mountable to a person playing the instrument, said transmitter being electrically connectable to said plectrum by said second wire.

12. A transmitter / receiver arrangement according to claim 11 wherein said transmitter is disposed upon, or housed within, a strap mountable to a wrist of said person.

13. A transmitter / receiver arrangement according to claim 12 wherein said strap includes means to house or mount a battery to power said radio frequency signal generator.

14. A transmitter / receiver arrangement according to any one of claims 10 to 13 wherein said string is electrically connected to an instrument-ground, which is, in turn, electrically connected to said receiver.

15. A transmitter / receiver arrangement according to any one of claims 10 to 14 wherein said signal generator is a radio frequency signal generator capable of producing a waveform at a carrier frequency, and said receiver circuitry is adapted to compare the carrier frequency with a local oscillator signal so as to only acknowledge a contact between the tip and the string once an intermediate frequency, which is a difference between the carrier frequency and the local oscillator frequency, is detected by the receiver, thereby reducing the likelihood of false triggering due to outside interference from radio frequency noise.

16. A transmitter / receiver arrangement according to claim 15 wherein both said carrier frequency and a frequency of said local oscillator signal are within the range 100 Khz to 30 MHz.

17. A transmitter / receiver arrangement according to claim 15 or 16 wherein said instrument-ground is electrically connected to a receiver-ground, said connection effectively forming an electrical short between said grounds at audio frequencies, and a first tuned receiver between said grounds which is broadly tuned at said carrier frequency.

18. A transmitter / receiver arrangement according to claim 16 wherein said connection is an inductor and a capacitor wired in parallel between the instrument-ground and the receiver-ground.

19. A transmitter / receiver arrangement according to claim 17 or 18 wherein, after passing through said connection, the radio frequency signal is amplified.

20. A transmitter / receiver arrangement according to any one of claims 17 to 19 wherein said receiver circuitry includes a selective band pass filter tuned at the intermediate frequency.

21. A transmitter / receiver arrangement according to claim 19 or 20 wherein said local oscillator signal is derived from a clock circuit of a microprocessor or from a frequency crystal.

22. A transmitter / receiver arrangement according to any one of claims 10 to 21 wherein said electronic monitoring circuitry includes a detector circuit adapted to output an envelope of the intermediate frequency component of the radio frequency signal, said envelope having brief pulses substantially corresponding to the period of time for which the plectrum tip is in contact with the string.

23. A transmitter / receiver arrangement according to claim 22 wherein said brief pulses are time-stretched so as to provide a modified signal having time-stretched pulses which would not be missed by a microprocessor.

24. A transmitter / receiver arrangement according to claim 23 wherein said electronic monitoring circuitry includes a microprocessor adapted to receive said modified signal and perform an analog-to-digital conversion thereto.

25. A transmitter / receiver arrangement according to claim 24 wherein said microprocessor is further adapted to detect positive transients in said modified signal and to generate said triggering signal by correlating each of said positive transients with an initial contact of the plectrum tip with the string.

26. A transmitter / receiver arrangement according to any one of claims 10 to 25 wherein said receiver circuitry is adapted to store and output a value corresponding to a maximum amplitude of an audio signal from said instrument each time the plectrum contacts the string.

27. A transmitter / receiver arrangement according to claim 26 wherein said electronic monitoring circuitry includes a microprocessor adapted to measure the stored value and to output a digital value corresponding to the amplitude.

28. A transmitter adapted for use with a plectrum as defined in any one of claims 1 to 9, said transmitter having a radio frequency signal generator electrically connectable to said tip such that, when said tip fleetingly connects with said string during plucking, the tip injects a radio frequency signal into the string.

29. A receiver adapted for use with the transmitter as defined in claim 28 including receiver circuitry being tuned to said radio frequency so as to detect the radio frequency signal injected into the string, the receiver being operatively associated with said electronic monitoring circuitry so as to provide said triggering signal.

30. A signal processing apparatus adapted to process an audio signal derived from a string instrument having a plurality of conductive strings being plucked by the plectrum defined in any one of claims 1 to 9, said apparatus including:

a first input to receive said audio signal;

a second input to receive a triggering signal which includes a plurality of triggering pulses, each indicative of a plucking of any of said strings by said plectrum tip;

signal processing circuitry adapted to perform a plurality of different processes, each process modifying the audio signal, said circuitry being electrically connected to said first and second inputs, and wherein said signal processing circuitry is adapted to vary the particular process used to modify the audio signal according to a predefined relationship with said triggering signal; and

an output electrically connected to said signal processing circuitry for outputting a modified audio signal.

31. A signal processing apparatus according to claim 30 wherein said predefined relationship is such that the process is varied each time an integral number of triggering pulses are received by the signal processing circuitry.

32. A signal processing apparatus according to claim 31 wherein said integral number is one.

33. A signal processing apparatus according to any one of claims 30 to 32 wherein, during a transition from a first process to a second process, the first process is progressively faded out and the second process is simultaneously progressively faded in.

34. A signal processing apparatus according to claim 33 wherein said transition commences upon receipt of a triggering pulse such that each transition is initiated substantially at each moment the tip first contacts the plectrum during plucking.

35. A signal processing apparatus according to any one of claims 30 to 34 wherein at least one of the operative characteristics of one or more of said processes is variable

dependent upon a maximum amplitude of the audio signal each time the plectrum contacts a string.

36. A signal processing apparatus according to any one of claims 30 to 35 wherein said plectrum communicates with said signal processing apparatus via the transmitter and/or receiver apparatus as defined in any one of claims 10 to 29.

37. A signal processing apparatus according to claim 36 when depended from claim 35 and wherein the transmitter / receiver arrangement is in accordance with claim 27, wherein the signal processing apparatus includes a third input to receive said digital value, said third input being adapted to feed said value to the signal processing circuitry.

38. A signal processing apparatus according to claim 37, wherein the second and third inputs comprise a single input which is adapted to receive and decode an information stream having information relating to both the triggering and the maximum amplitude.

39. A plectrum substantially as herein described with reference to any one embodiment as shown in the accompanying drawings.

40. A transmitter / receiver arrangement substantially as herein described with reference to any one embodiment as shown in the accompanying drawings.

41. A transmitter substantially as herein described with reference to any one embodiment as shown in the accompanying drawings.

42. A receiver substantially as herein described with reference to any one embodiment as shown in the accompanying drawings.

43. A signal processing apparatus substantially as herein described with reference to any one embodiment as shown in the accompanying drawings.

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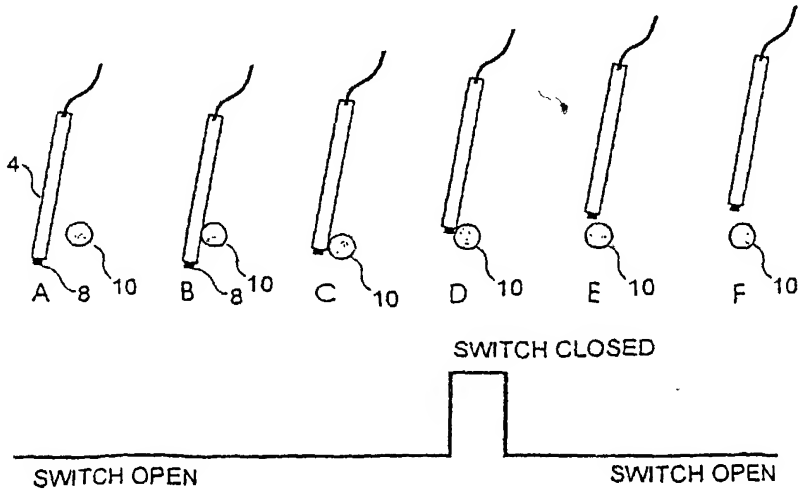
(54) Title: A PLECTRUM FOR A STRING INSTRUMENT, A TRANSMITTER/RECEIVER ARRANGEMENT AND A SIGNAL PROCESSING APPARATUS



(57) Abstract: A plectrum (4) for a stringed musical instrument having a plurality of conductive strings (10) is provided with a non-conductive body (5) and a conductive tip (8). The conductive tip (8) is sized so as to fleetingly contact a string (10) when the string is plucked with a plectrum. The tip (8) is electrically connected to monitoring circuitry which provides a triggering signal each time the tip contacts any of the strings (10). A transmitter and receiver arrangement is provided to monitor the contact of the tip (8) with the strings (10) and generate the triggering signal. The triggering signal is in turn received by a signal processing apparatus which modifies the audio signal output from the stringed musical instrument under the control of the triggering signal.

WO 01/03107 A1

Fig 1

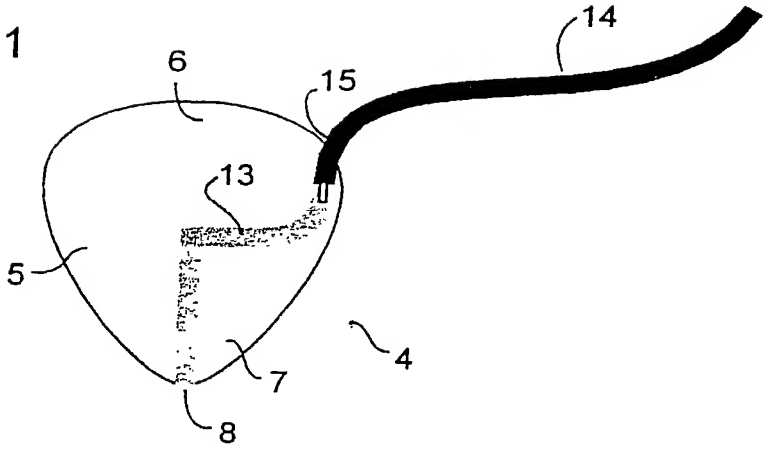
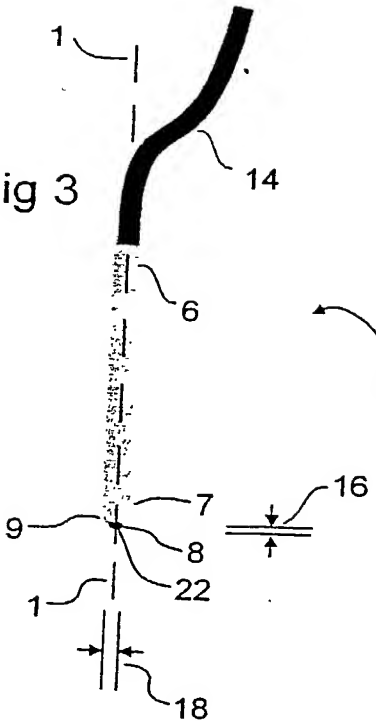
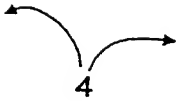


Fig 3





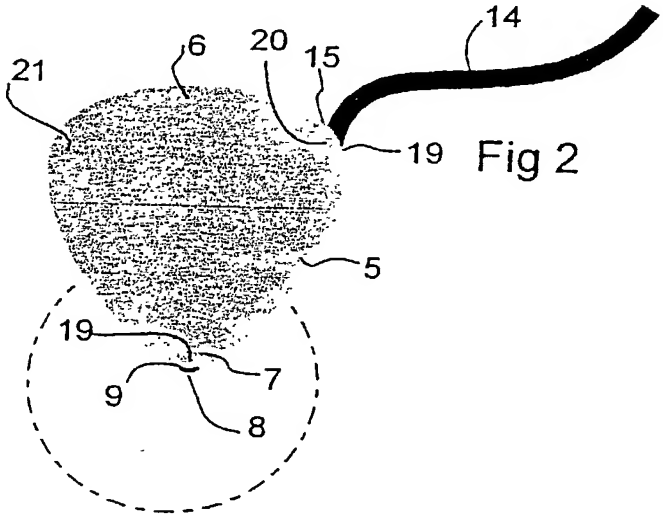


Fig 2

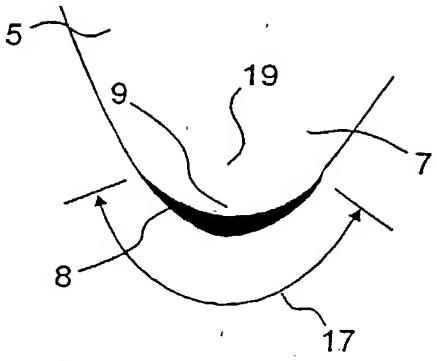


Fig 2A

Fig 4

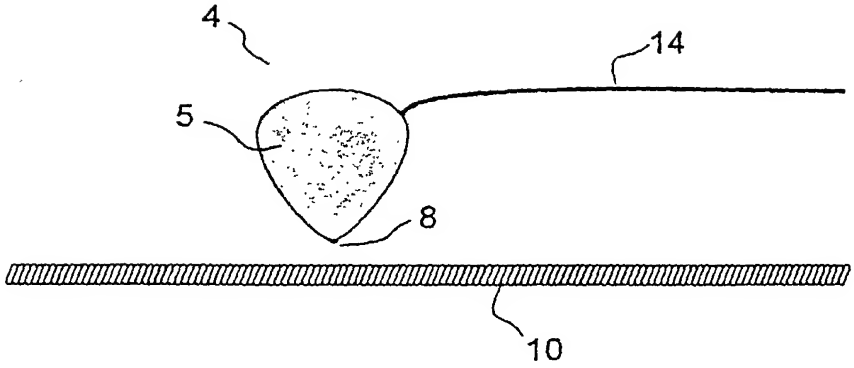
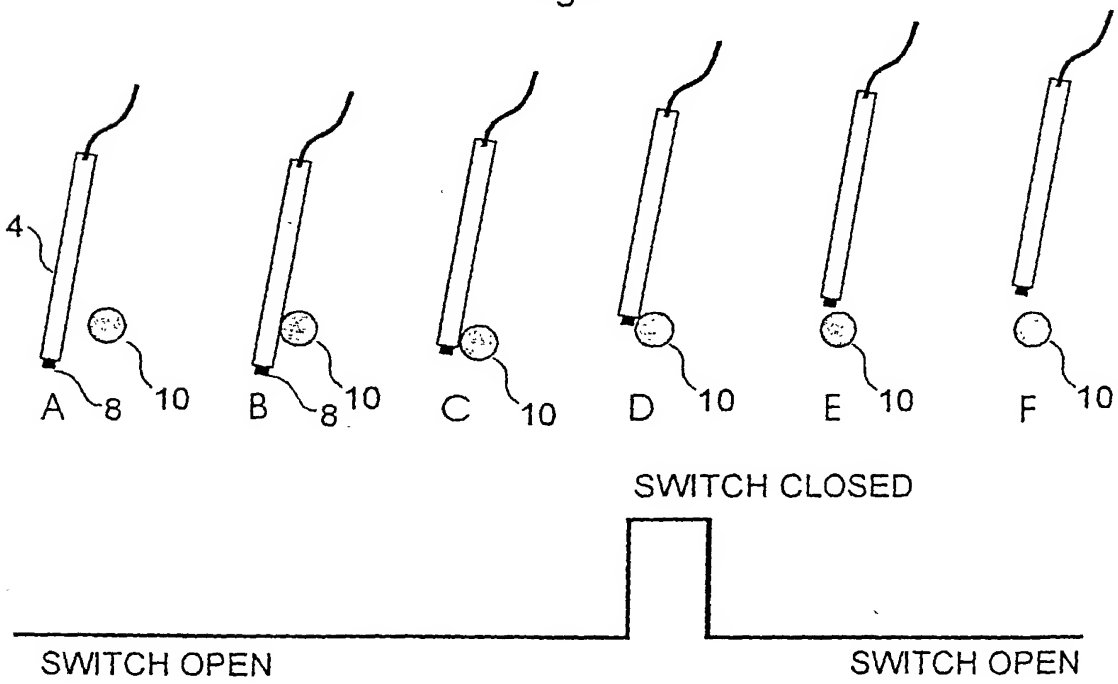

4
14
5
8
10

Fig 5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B
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C
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D
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E
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F
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SWITCH OPEN

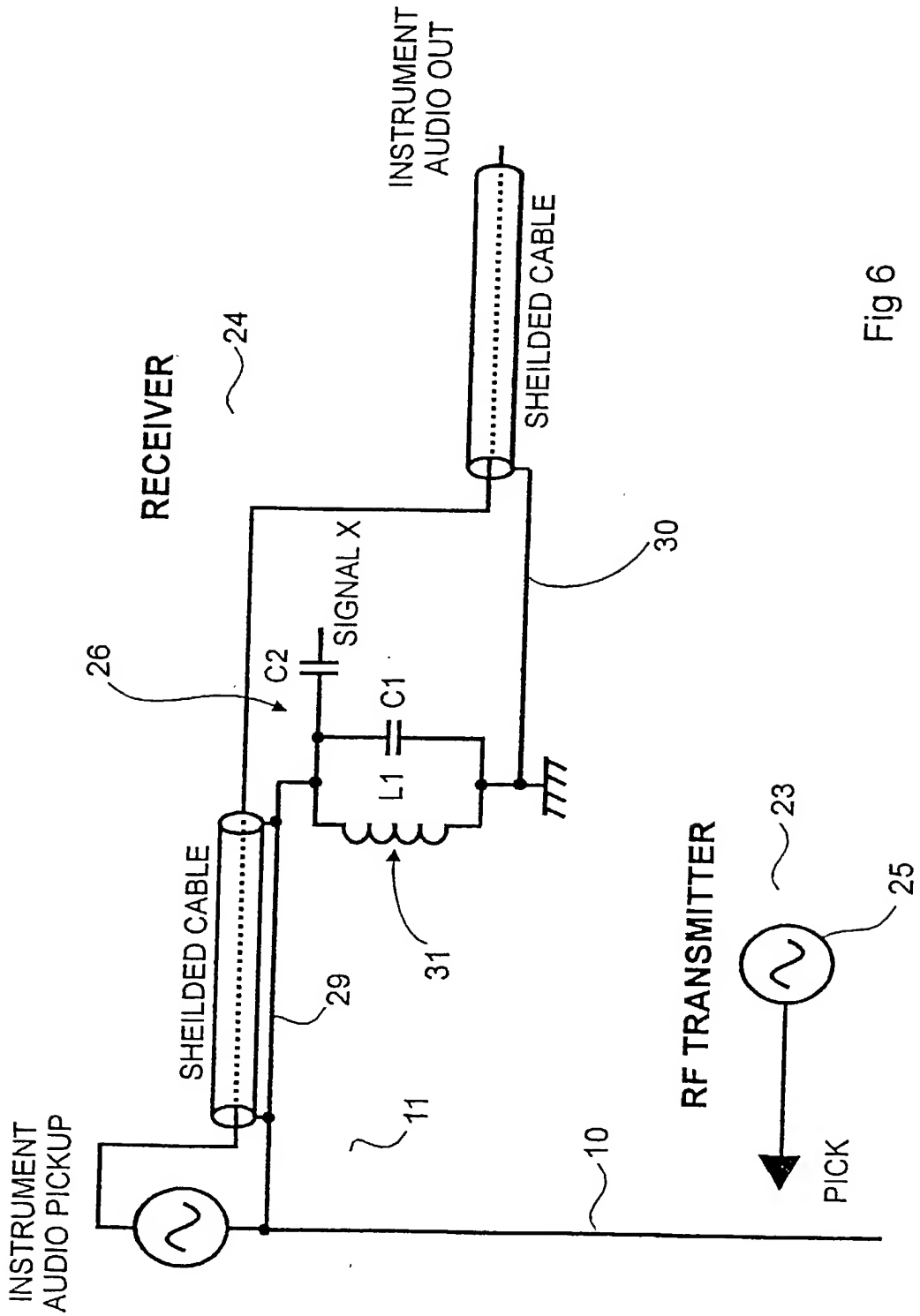

INSTRUMENT AUDIO OUT
SHEILDED CABLE
RECEIVER
24
30
SIGNAL X
C2
C1
26
L1
31
SHEILDED CABLE
29
11
10
RF TRANSMITTER
23
25
PICK
INSTRUMENT AUDIO PICKUP

Fig 6

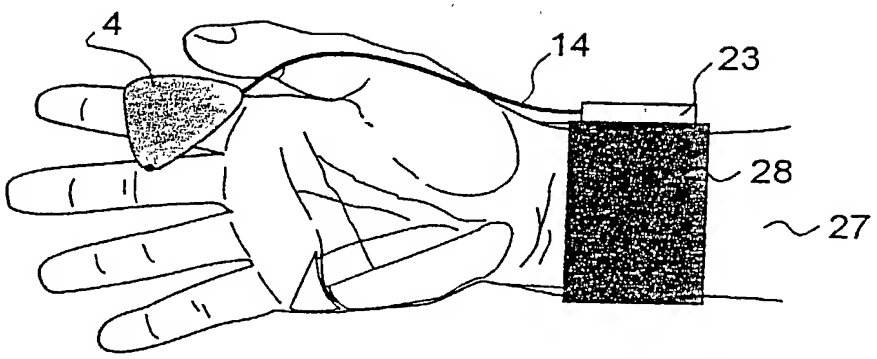


Fig 7

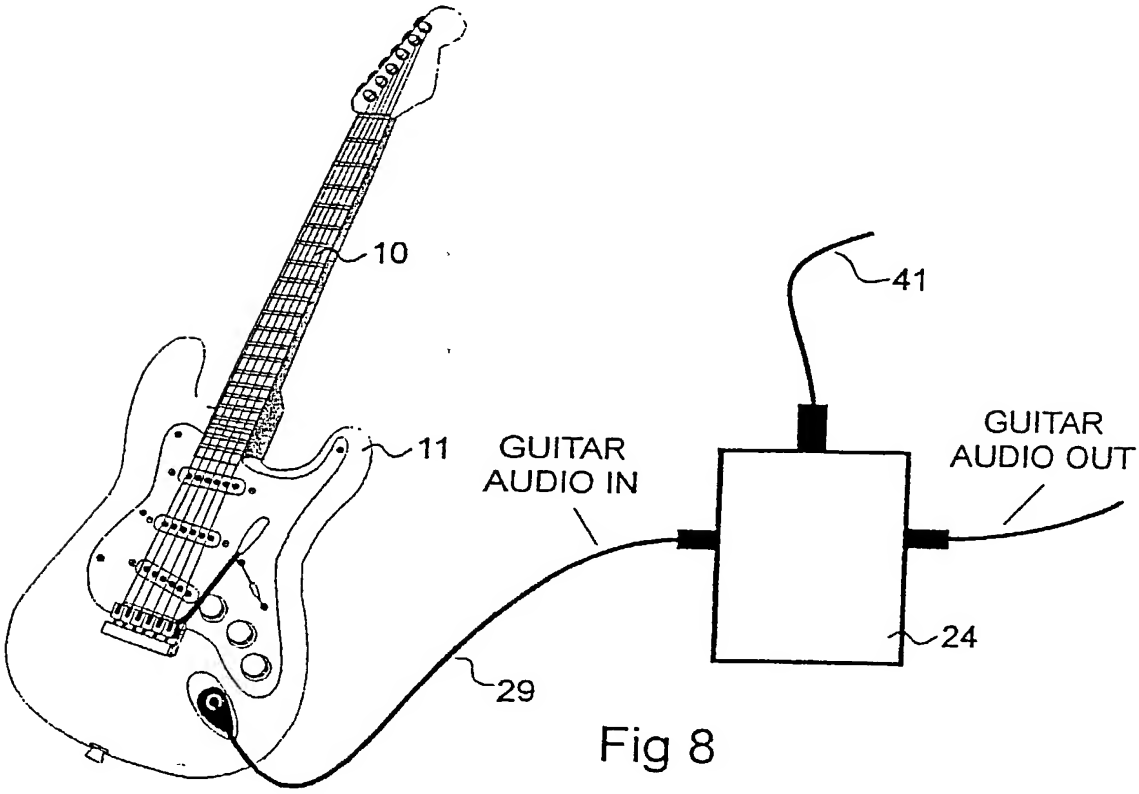
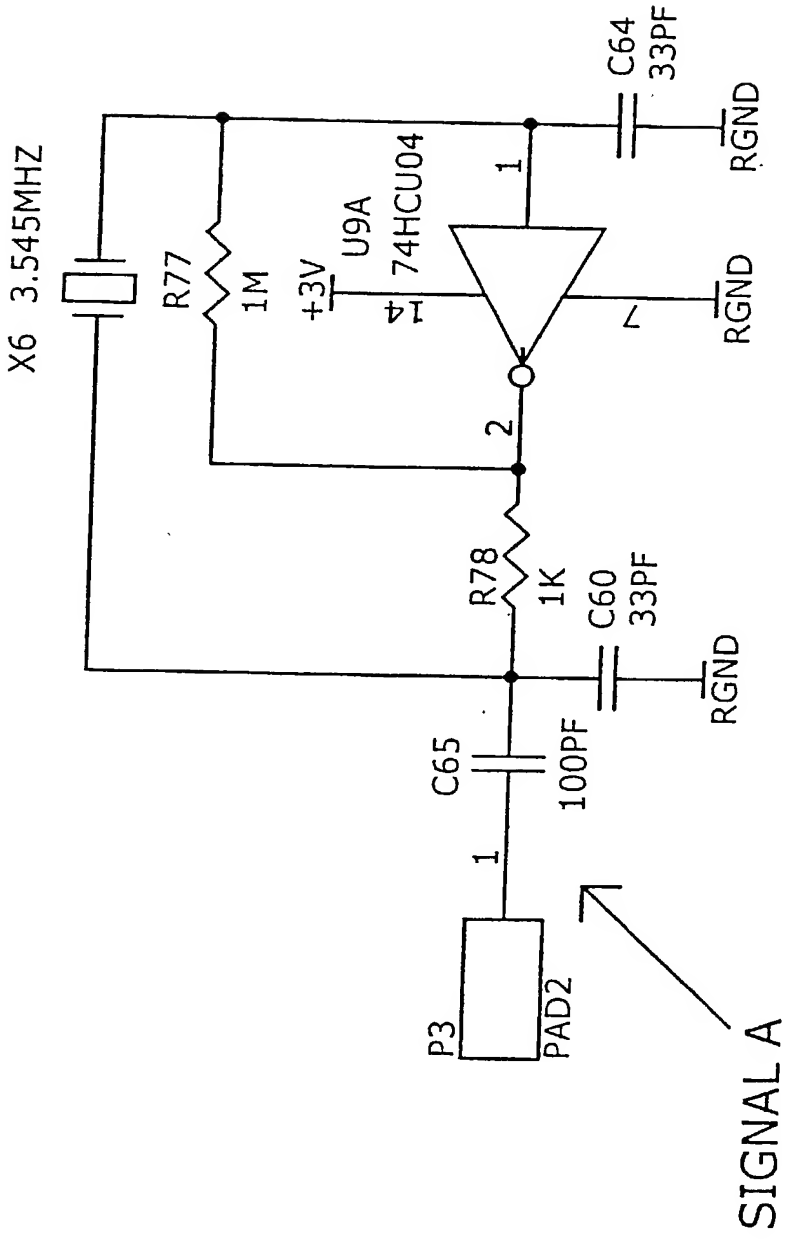


Fig 8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C64
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RGND
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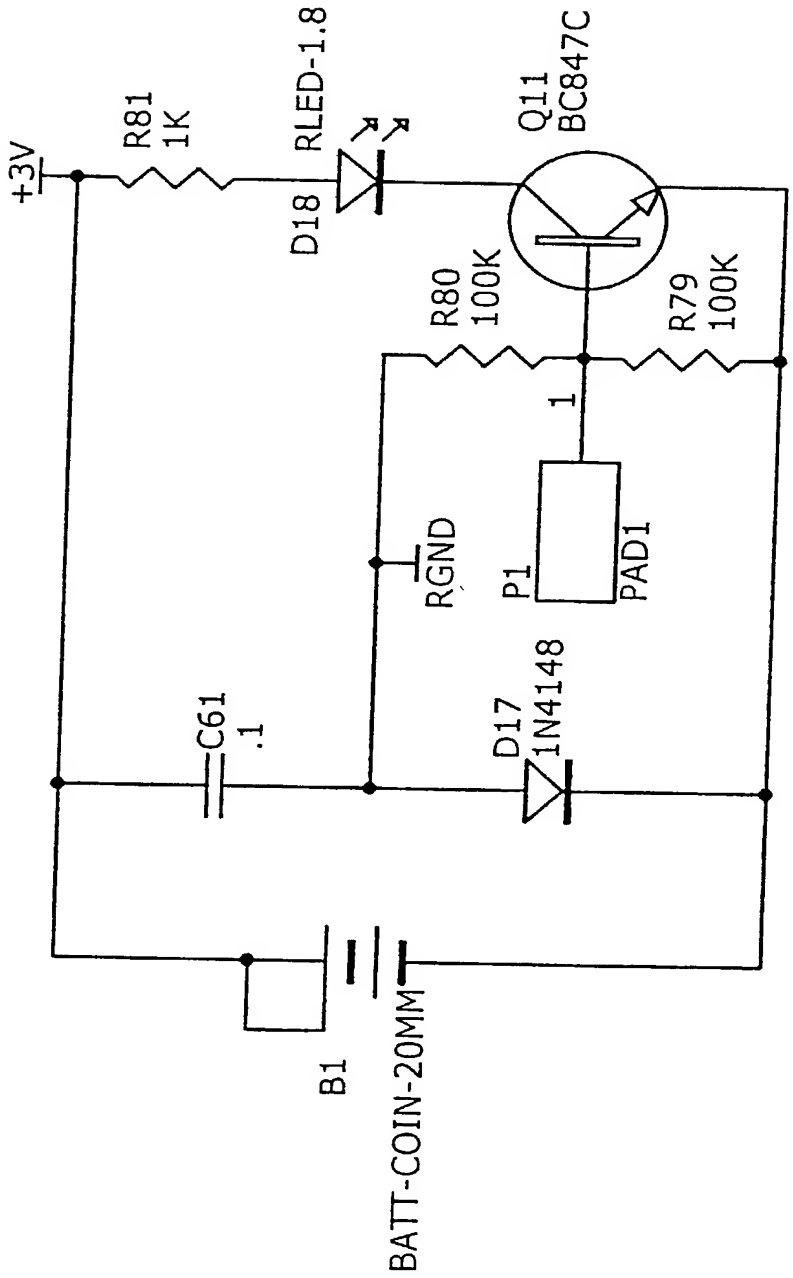
P3
PAD2
SIGNAL A

Fig 9a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D17
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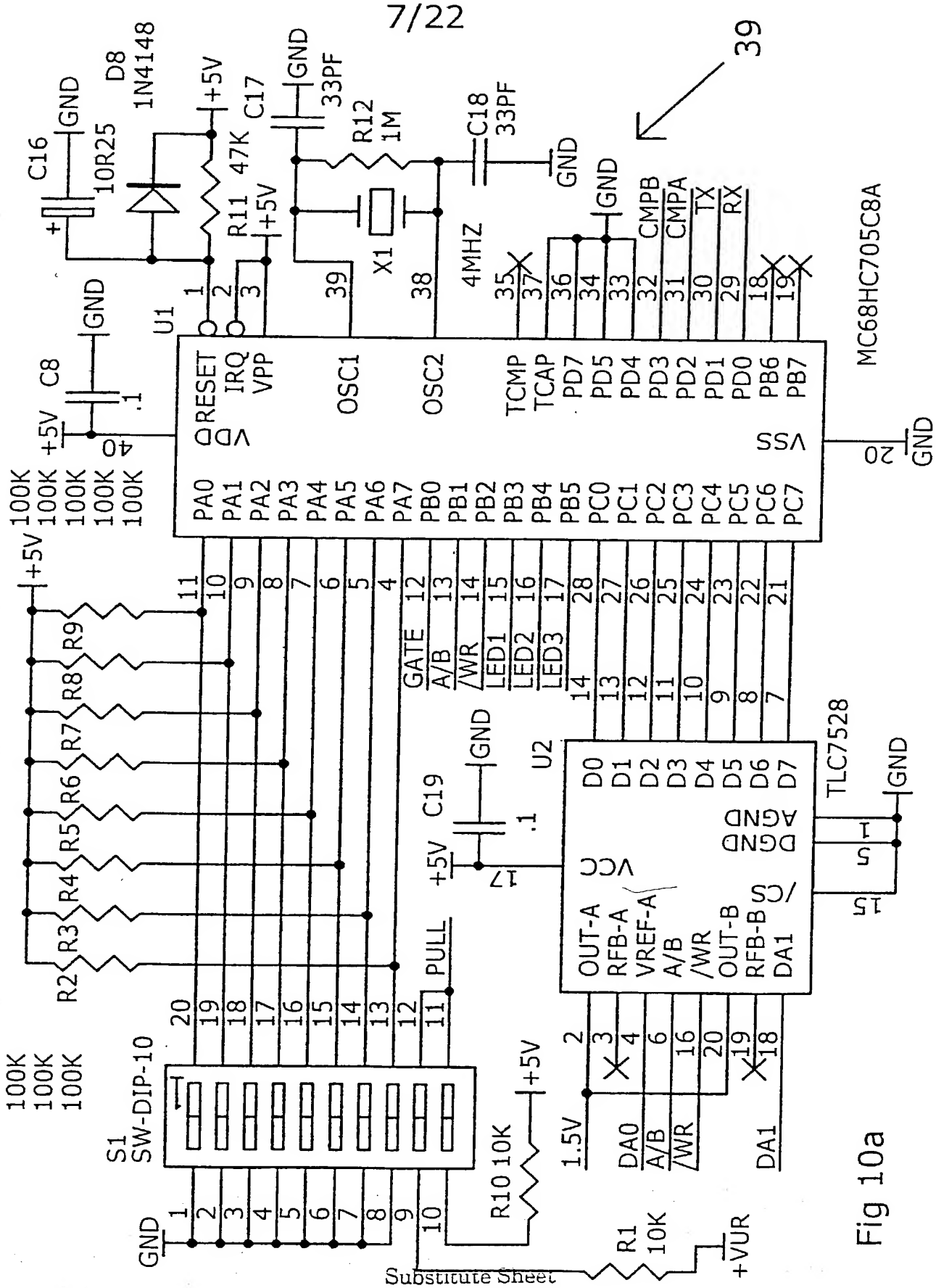
BATT-COIN-20MM

Fig 9b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R3
R4
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PD0
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PC6
PC7
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RX
GATE
A/B
/WR
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LED2
LED3
PULL
D0
D1
D2
D3
D4
D5
D6
D7
VCC
DGND
AGND
/CS
OUT-A
RFB-A
VREF-A
A/B
/WR
OUT-B
RFB-B
DA1
DA0
100K

Fig 10a

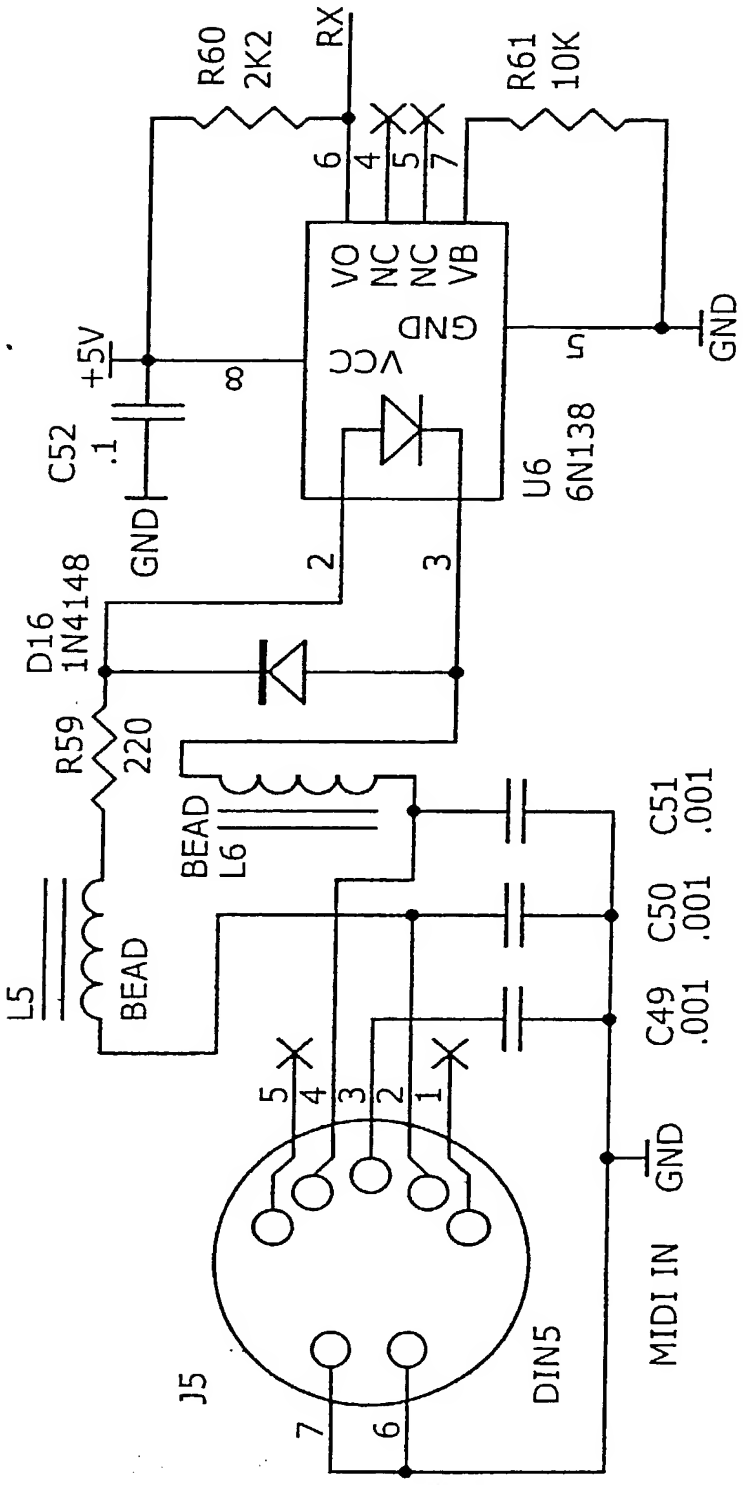
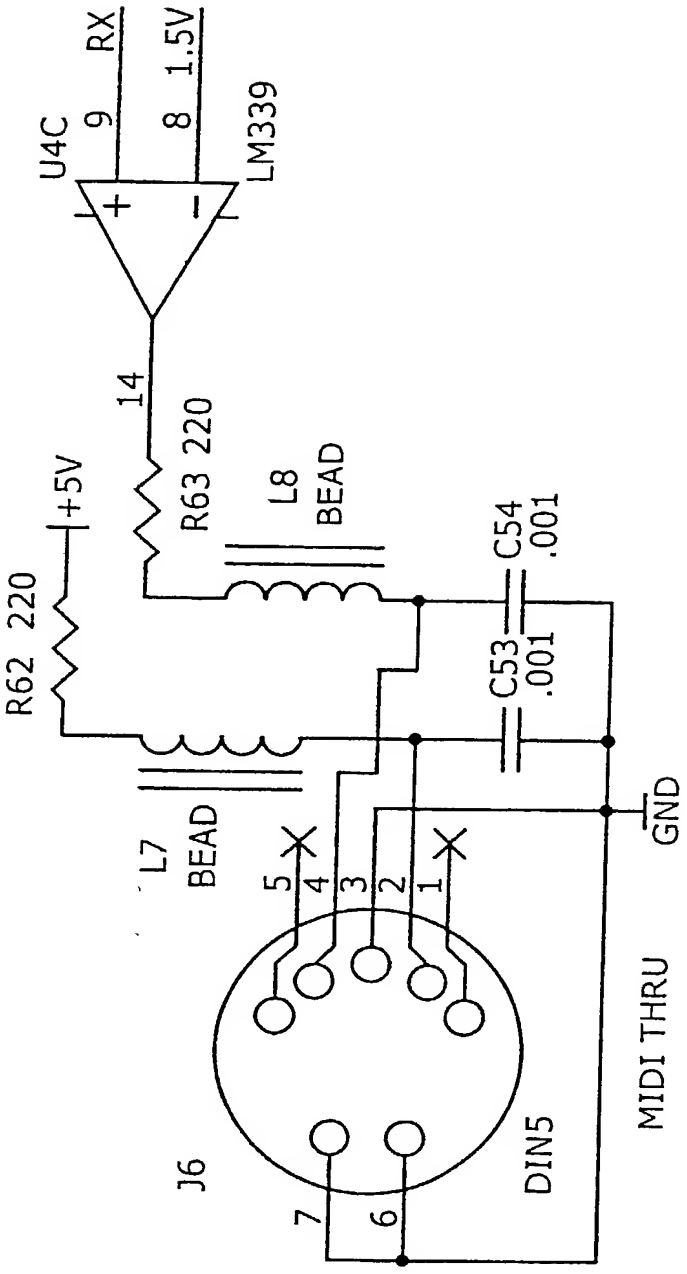

R60
2K2
RX
R61
10K
6
4
5
7
VO
NC
NC
VB
GND
VCC
+5V
8
5
GND
C52
.1
GND
U6
6N138
2
3
D16
1N4148
R59
220
BEAD
L6
BEAD
L5
C51
.001
C50
.001
C49
.001
5
4
3
2
1
GND
MIDI IN
J5
DIN5
7
6

Fig 10b

Fig 10c


U4C
9
RX
8
1.5V
LM339
+
−
14
R63 220
L8
BEAD
+5V
R62 220
C54
.001
C53
.001
L7
BEAD
GND
5
4
3
2
1
J6
DIN5
MIDI THRU
7
6

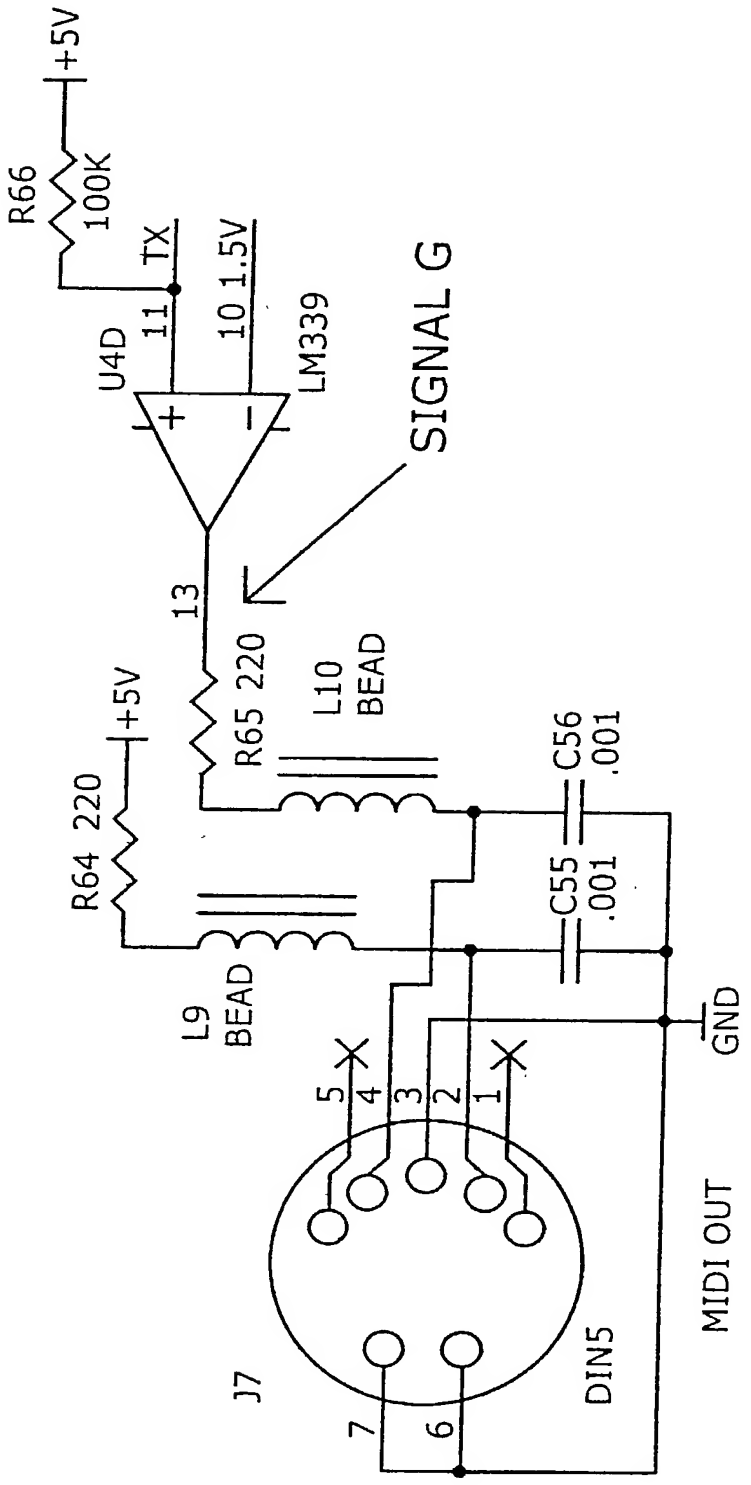

+5V
R66
100K
TX
11
10
1.5V
U4D
LM339
SIGNAL G
13
R65 220
L10
BEAD
+5V
R64 220
C56
.001
C55
.001
L9
BEAD
GND
5
4
3
2
1
J7
DIN5
MIDI OUT
7
6

Fig 10d

Fig 10e

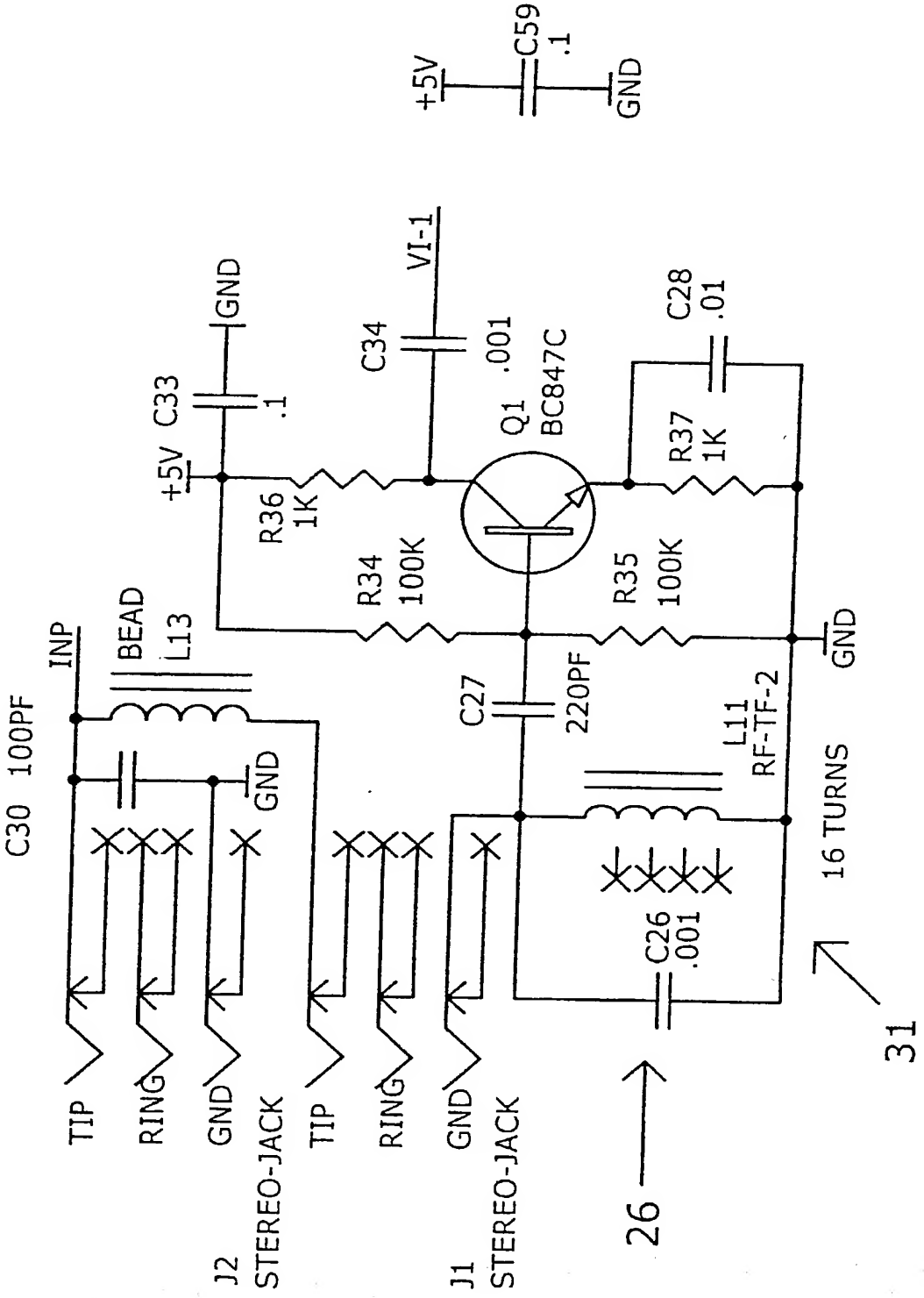
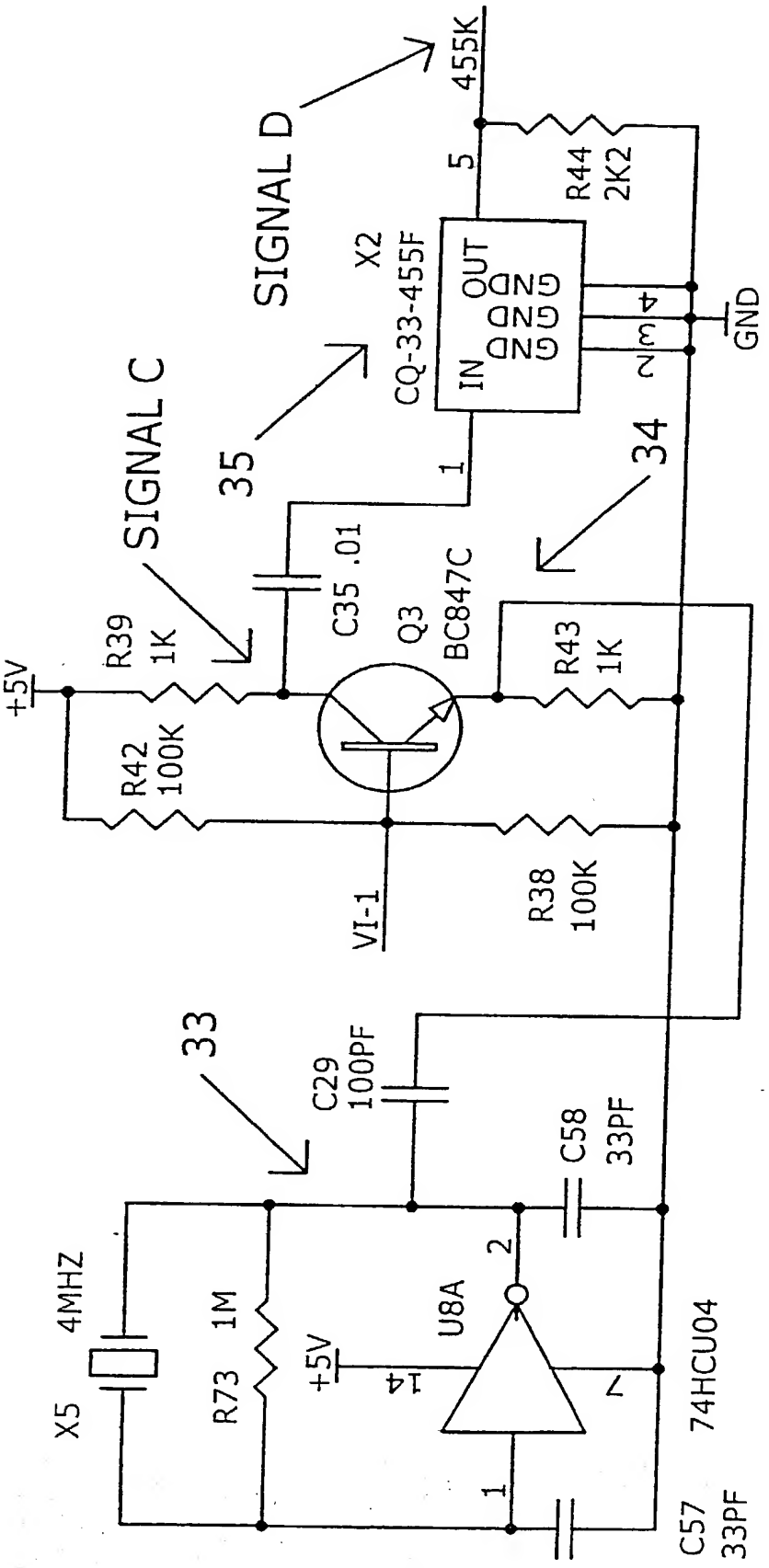

+5V
C59
.1
GND
VI-1
C34
.001
Q1
BC847C
C28
.01
GND
C33
.1
+5V
R36
1K
R37
1K
R34
100K
R35
100K
INP
BEAD
L13
C30 100PF
GND
C27
220PF
L11
RF-TF-2
GND
16 TURNS
C26
.001
TIP
RING
GND
J2
STEREO-JACK
TIP
RING
GND
J1
STEREO-JACK
26
31

Fig 10f


SIGNAL D
455K
5
R44
2K2
X2
CQ-33-455F
OUT
GND
GND
GND
IN
4
3
2
1
GND
35
SIGNAL C
34
C35 .01
Q3
BC847C
R43
1K
R39
1K
+5V
R42
100K
VI-1
R38
100K
33
C29
100PF
C58
33PF
4MHZ
X5
R73
1M
+5V
14
U8A
2
7
1
74HCU04
C57
33PF

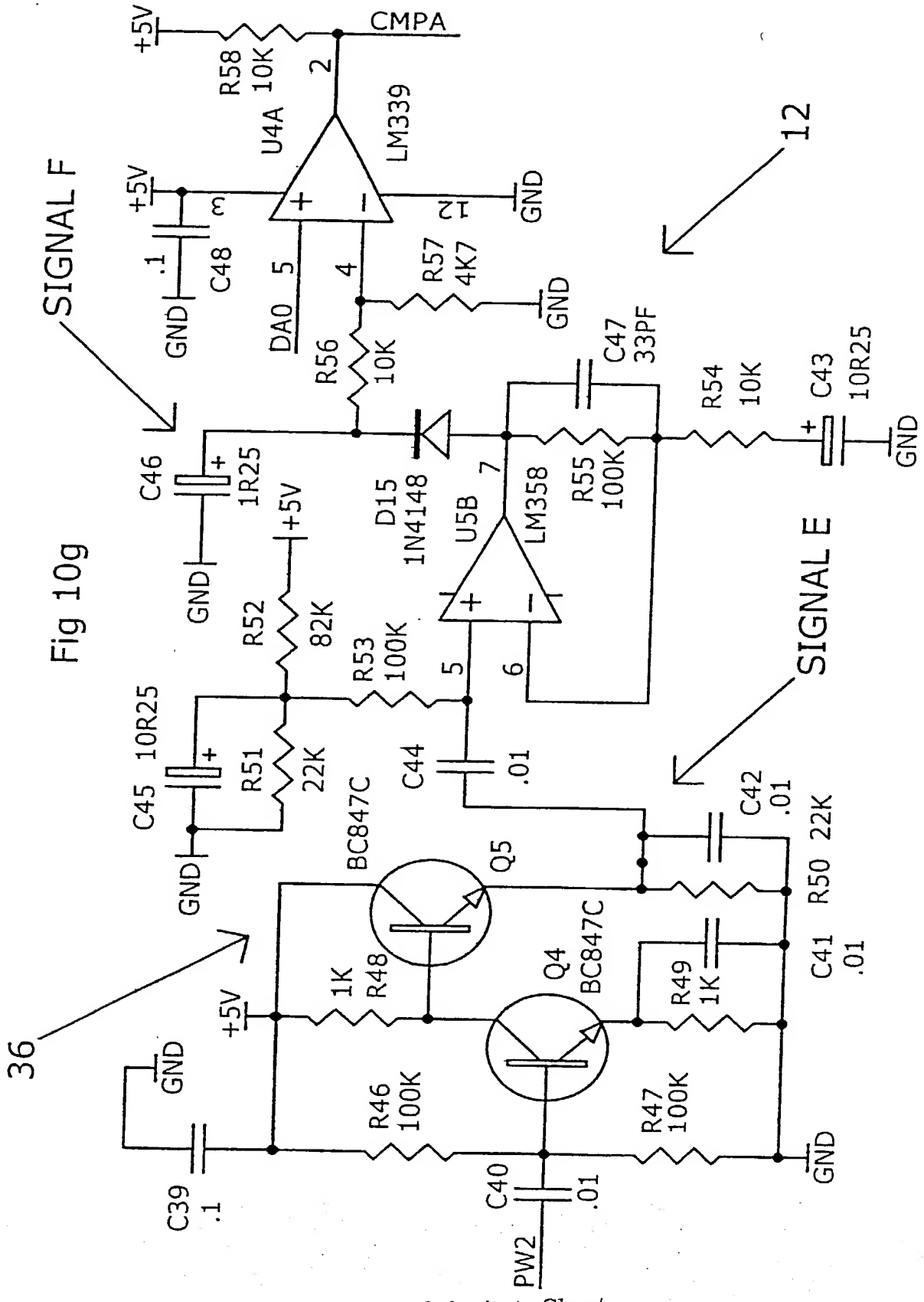
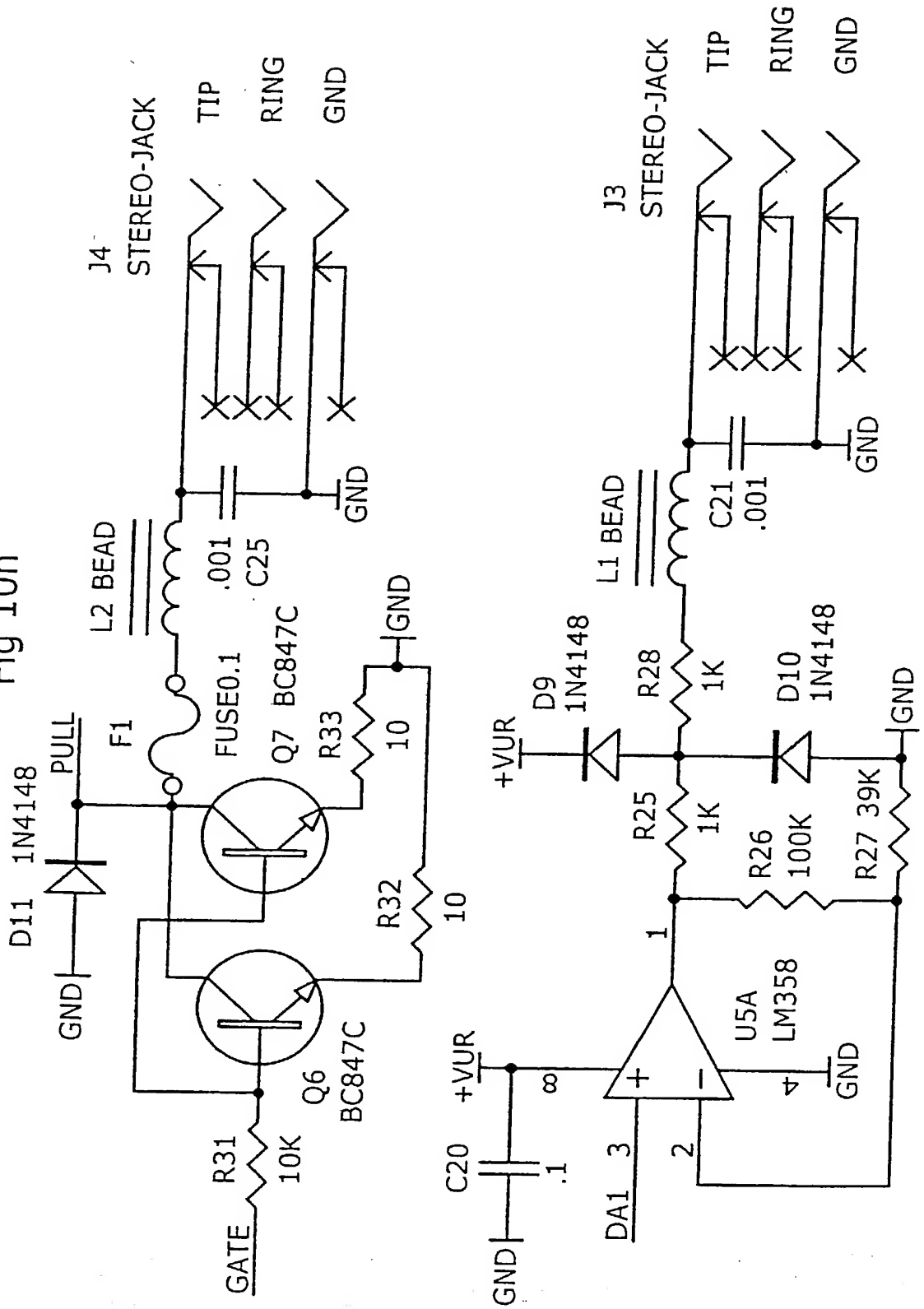

+5V
R58 10K
CMPA
2
U4A
LM339
+5V
3
1
GND
.1
C48
GND
DA0
5
4
R57 4K7
GND
R56 10K
C47 33PF
R54 10K
C43 10R25
GND
SIGNAL F
12
C46 1R25
GND
+5V
R52 82K
D15 1N4148
U5B
LM358
7
R55 100K
SIGNAL E
R53 100K
5
6
C45 10R25
R51 22K
C44 .01
C42 .01
R50 22K
BC847C
Q5
GND
36
+5V
1K R48
Q4 BC847C
R49 1K
C41 .01
GND
R46 100K
R47 100K
GND
C39 .1
C40 .01
PW2

Fig 10g

Fig 10h


J4
STEREO-JACK
TIP
RING
GND
L2 BEAD
.001
C25
GND
F1
FUSE0.1
Q7 BC847C
R33
10
GND
PULL
D11 1N4148
GND
R32
10
Q6
BC847C
R31
10K
GATE
J3
STEREO-JACK
TIP
RING
GND
L1 BEAD
C21
.001
GND
D9
1N4148
R28
1K
D10
1N4148
GND
+VUR
R25
1K
R26
100K
R27 39K
1
U5A
LM358
8
4
+VUR
C20
.1
GND
DA1
3
2

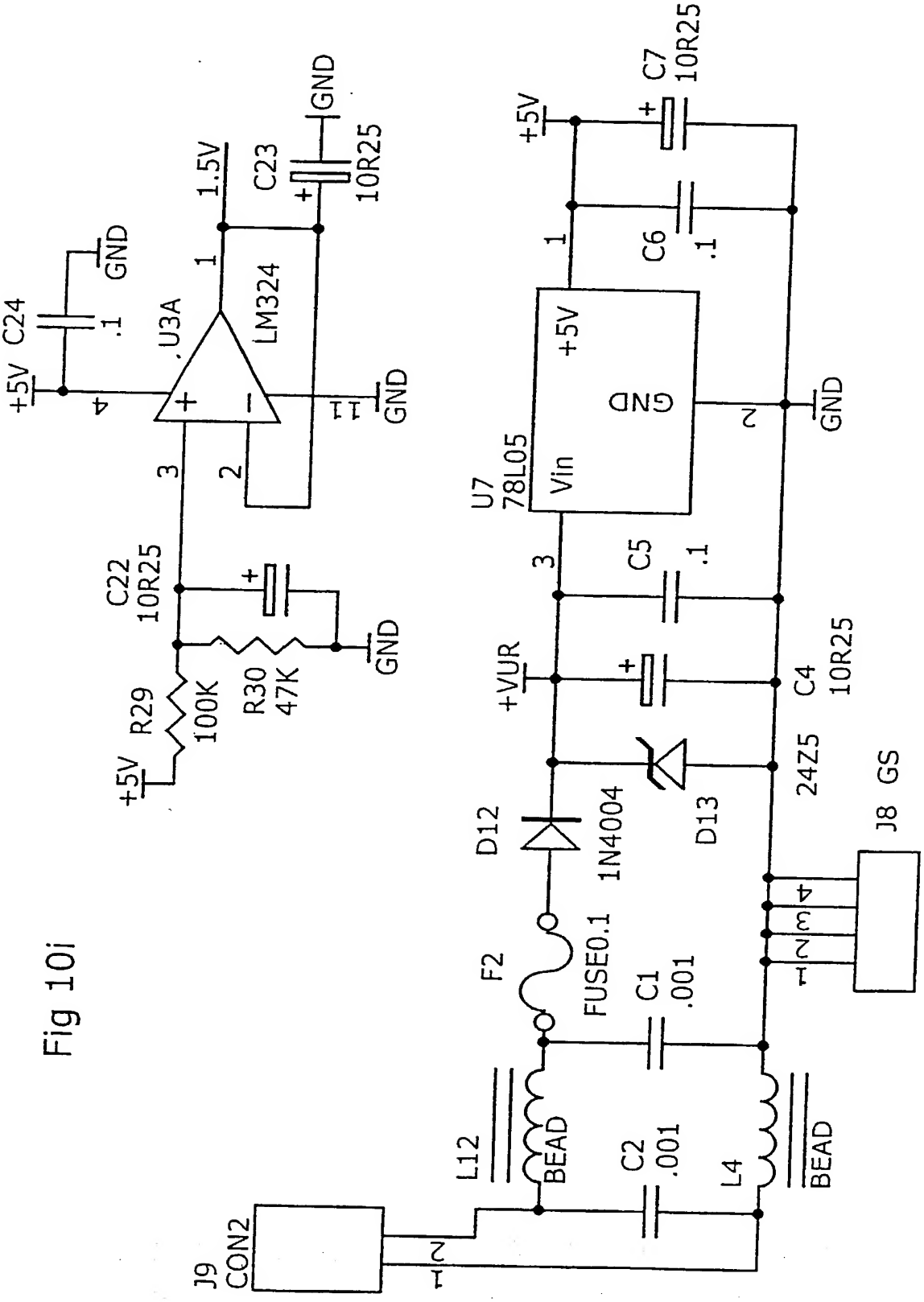

+5V
C24
.1
GND
U3A
LM324
1.5V
C23
10R25
GND
C22
10R25
R29
100K
R30
47K
GND
+5V
U7
78L05
Vin
GND
+5V
C7
10R25
C6
.1
C5
.1
+VUR
C4
10R25
24Z5
D12
1N4004
D13
F2
FUSE0.1
C1
.001
J8 GS
L12
BEAD
C2
.001
L4
BEAD
J9
CON2

Fig 10i

Fig 10j

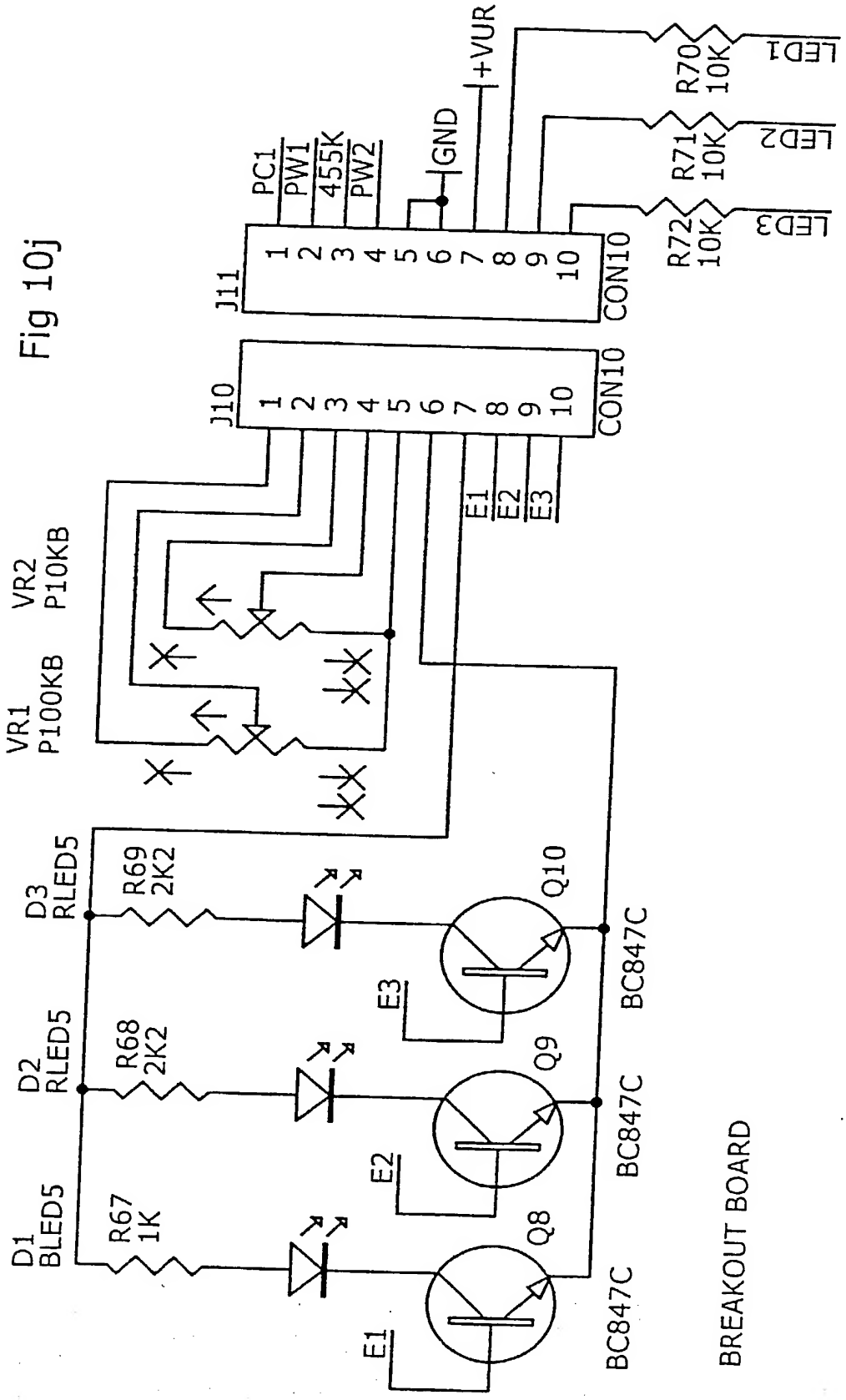

BREAKOUT BOARD
J11
CON10
PC1
PW1
455K
PW2
GND
+VUR
LED1
LED2
LED3
R70 10K
R71 10K
R72 10K
J10
CON10
E1
E2
E3
VR1 P100KB
VR2 P10KB
D3 RLED5
R69 2K2
Q10
BC847C
D2 RLED5
R68 2K2
Q9
BC847C
D1 BLED5
R67 1K
Q8
BC847C

Fig 10k

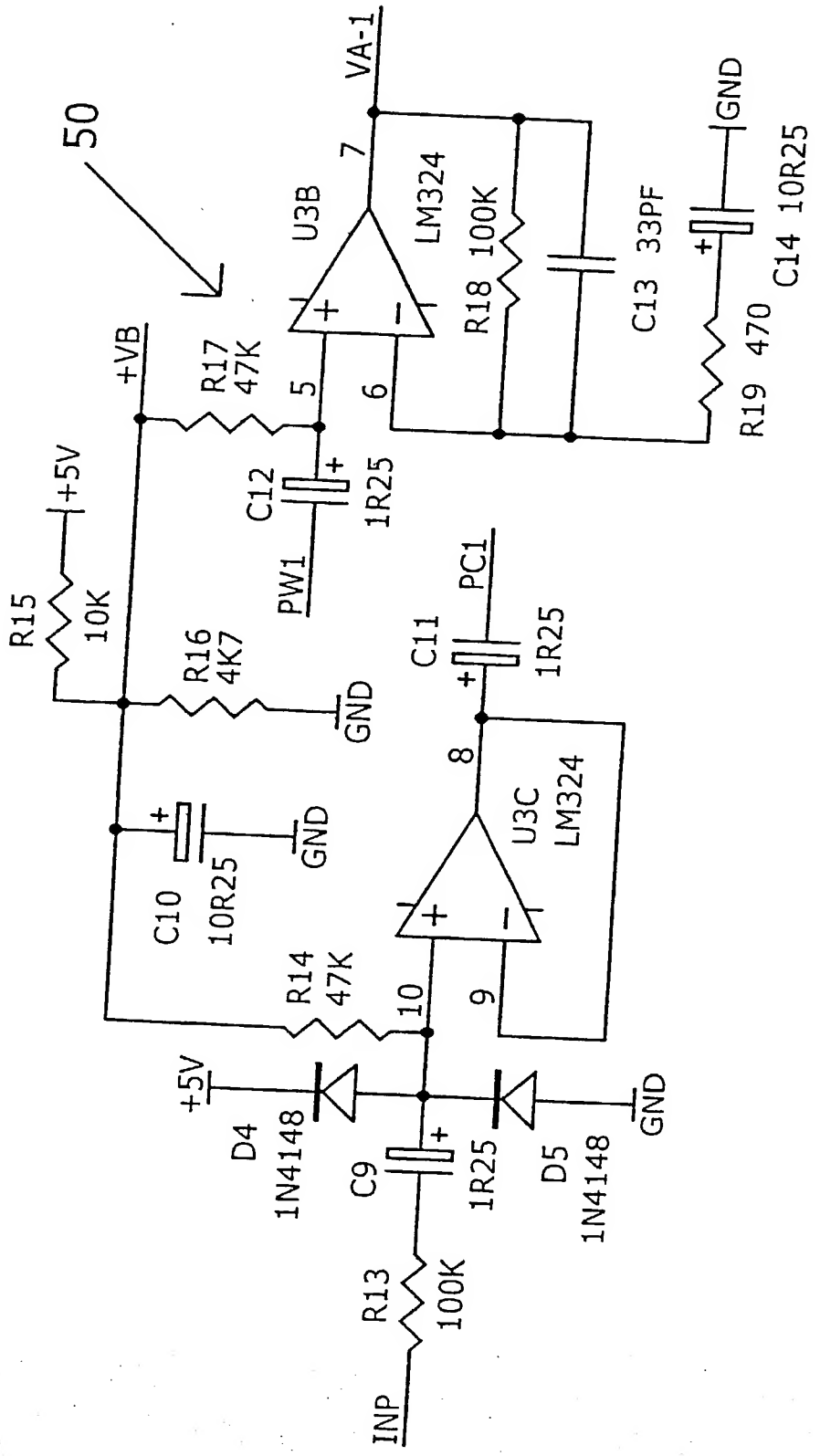

50
VA-1
U3B
LM324
7
5
6
+VB
R17
47K
R18 100K
C13 33PF
GND
C14 10R25
R19 470
C12
1R25
PW1
+5V
R15
10K
R16
4K7
GND
C11
PC1
1R25
8
U3C
LM324
C10
10R25
GND
R14
47K
10
9
+5V
D4
1N4148
C9
1R25
D5
1N4148
GND
R13
100K
INP

Fig 10L

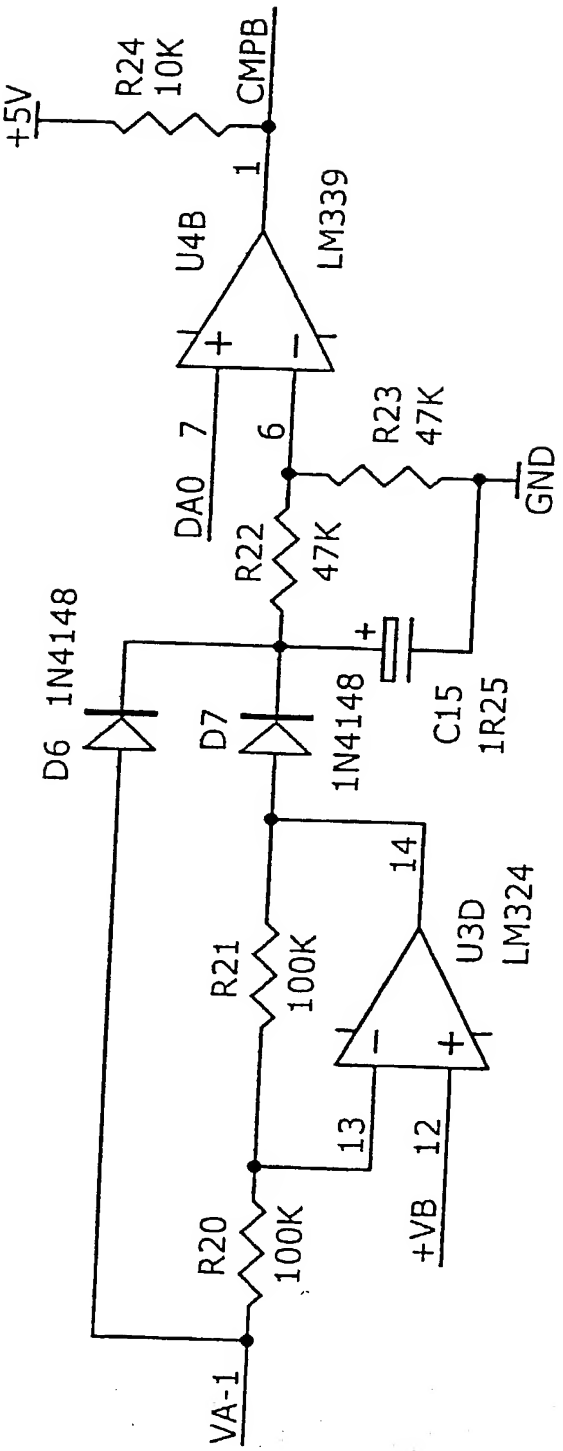

+5V
R24
10K
CMPB
1
U4B
LM339
+
−
7
6
DA0
R22
47K
R23
47K
GND
D6 1N4148
D7
1N4148
C15
1R25
14
U3D
LM324
R21
100K
13
12
+VB
R20
100K
VA-1

Fig 11 SIGNAL A

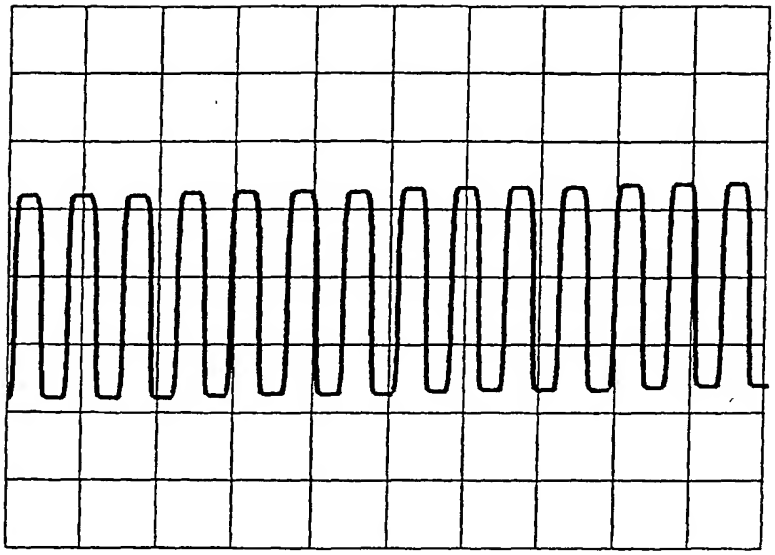


Fig 12 SIGNAL B

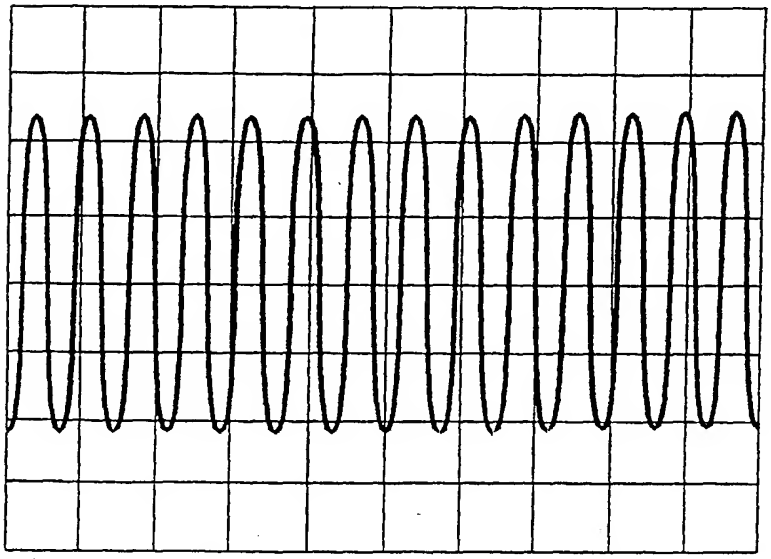


Fig 13 SIGNAL C

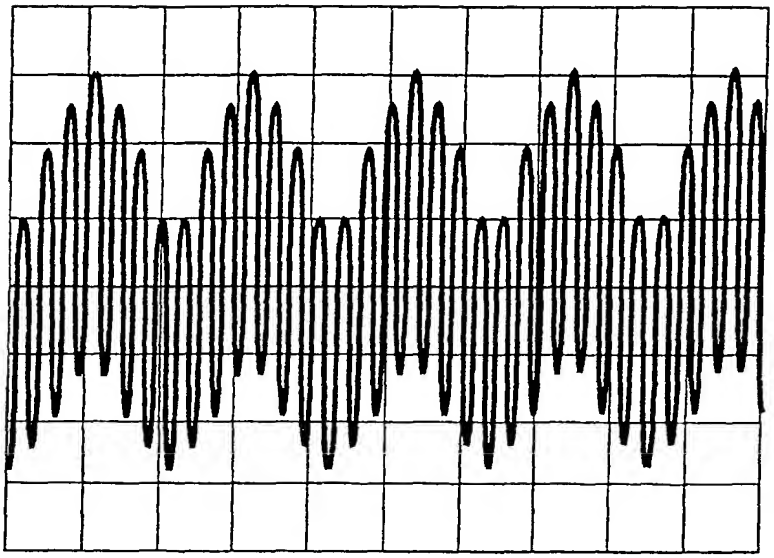
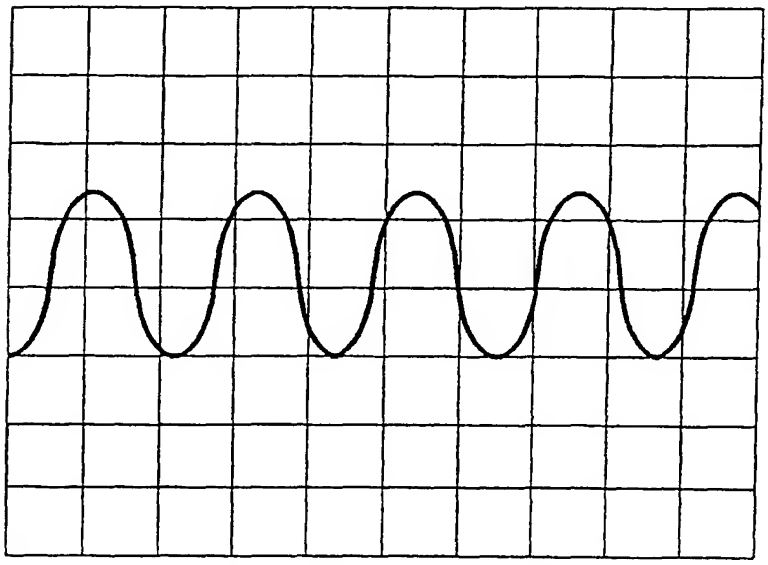


Fig 14 SIGNAL D



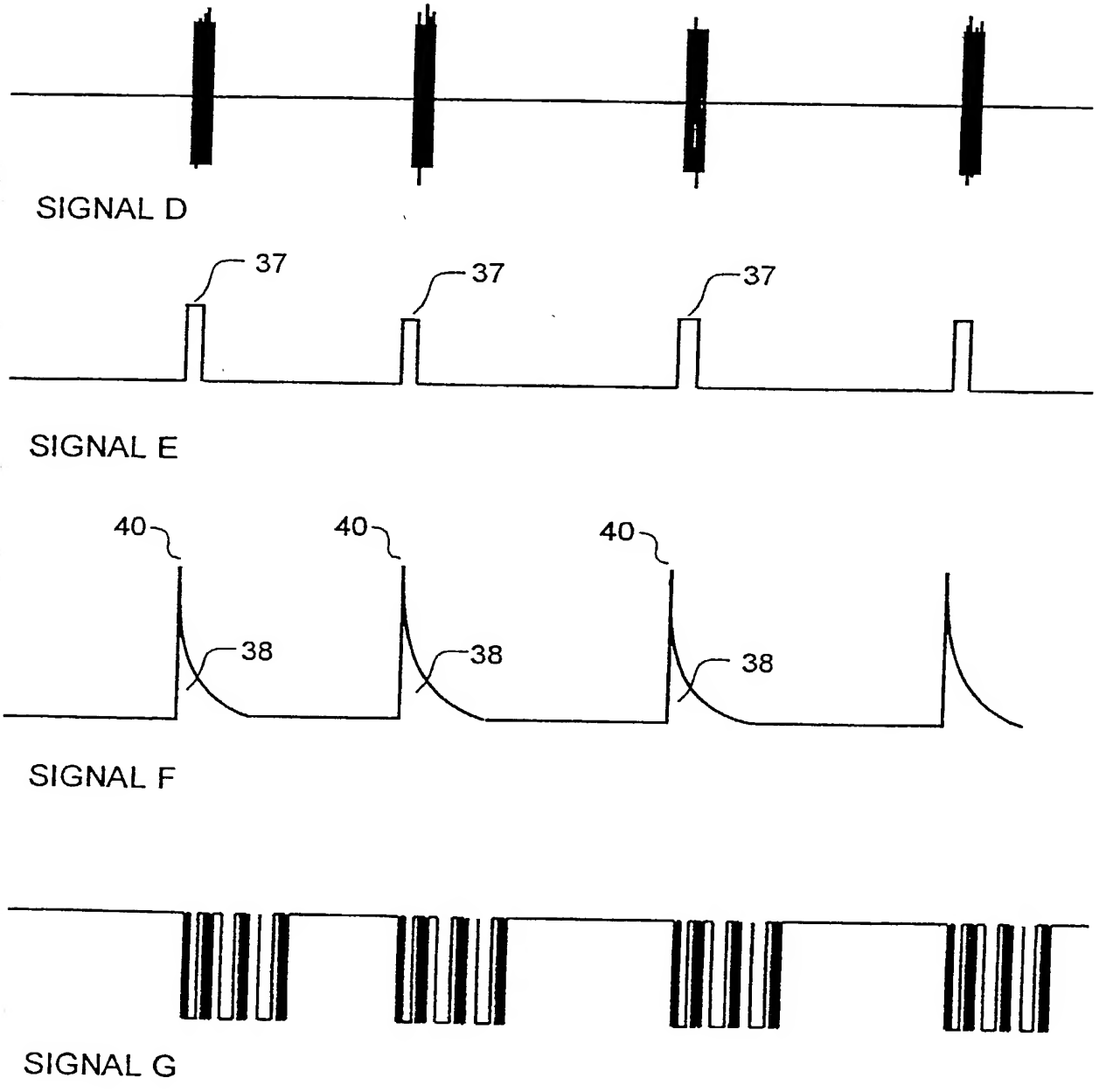


Fig 15

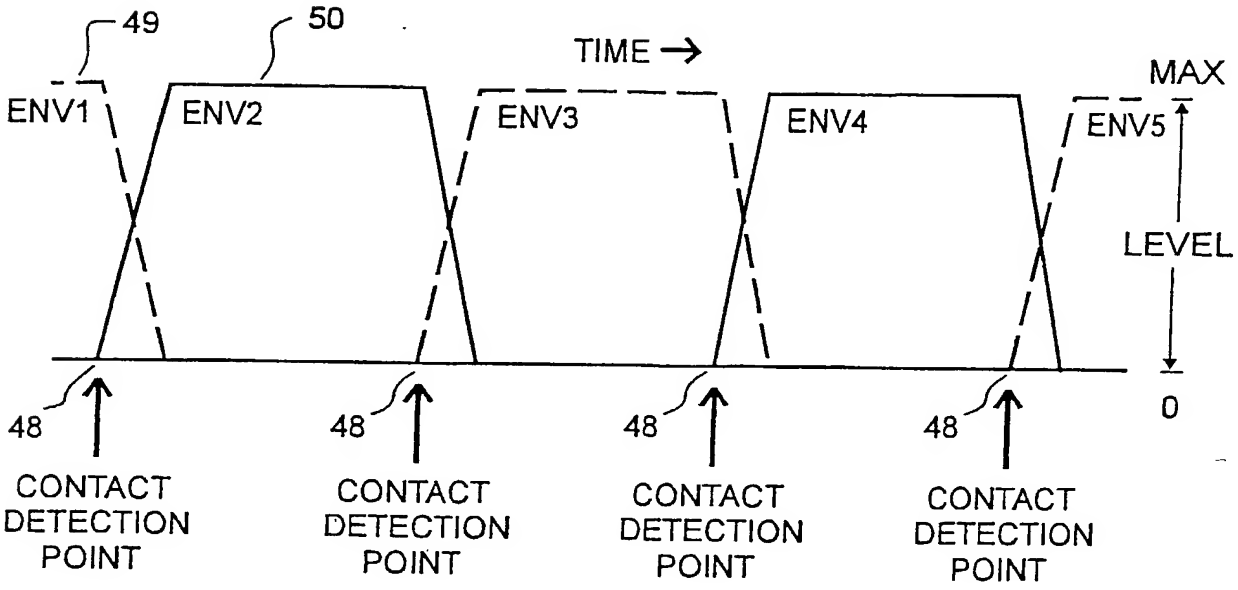

49
50
TIME →
MAX
ENV1
ENV2
ENV3
ENV4
ENV5
LEVEL
0
48
48
48
48
CONTACT DETECTION POINT
CONTACT DETECTION POINT
CONTACT DETECTION POINT
CONTACT DETECTION POINT

FIG 16

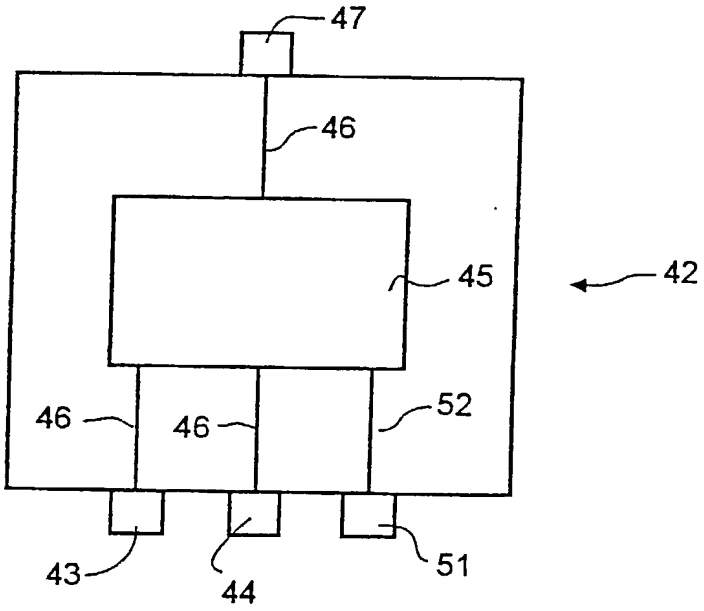

47
46
45
42
46
46
52
43
44
51

FIG 17

PATENT APPLICATION/PCT
Attorney's Docket No. 2920-012194

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	:	
Steve CHICK	:	**A PLECTRUM FOR A STRING INSTRUMENT A TRANSMITTER/RECEIVER ARRANGEMENT AND A SIGNAL PROCESSING APPARATUS**
International Application No. PCT/AU00/00808	:	
International Filing Date 05 July 2000	:	
Priority Date Claimed 06 July 1999	:	
Serial No. Not Yet Assigned	:	
Filed Concurrently Herewith	:	

Pittsburgh, Pennsylvania
January 4, 2002

LETTER RECOGNIZING ATTORNEYS

BOX PCT
Commissioner for Patents
Washington DC 20231

Sir:

Enclosed are appropriate papers for initiating the national phase of the above-identified PCT application, comprising a specification, claims, drawings and search report. A Preliminary Amendment is also enclosed.

Please accept the application for purposes of granting a filing date and recognize Russell D. Orkin, Blynn L. Shideler and Paul M. Reznick, Registration Nos. 25,363, 35,034 and 33,059, respectively, as attorneys in this application, pending the filing of a formal Declaration and Power of Attorney.

Kindly direct all communications relating to this application to **Russell D. Orkin**.

Respectfully submitted,

WEBB ZIESENHEIM LOGSDON
ORKIN & HANSON, P.C.

By _____

Russell D. Orkin, Reg. No. 25,363
Attorney for Applicant
700 Koppers Building
436 Seventh Avenue
Pittsburgh, PA 15219-1818
Telephone: 412/471-8815
Facsimile: 412/471-4094

Declaration and Power of Attorney For Patent Application

English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

A Plectrum for a String Instrument, a Transmitter/Receiver Arrangement and a Signal for Processing Apparatus ✓

the specification of which (check one)

☐ is attached hereto.

☒ was filed on **January 4, 2002** ✓ as

Application Serial No. **10/019,984** ✓

and was amended on January 4, 2002 ✓ and (if applicable).

was filed as PCT/AU00/00808 on July 5, 2000

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
PQ1446 ✓ (Number)	**Australia** ✓ (Country)	**06 July 1999** ✓ (Day/Month/Year Filed)	☒ Yes	☐ No
(Number)	(Country)	(Day/Month/Year Filed)	☐ Yes	☐ No
(Number)	(Country)	(Day/Month/Year Filed)	☐ Yes	☐ No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

Russell D. Orkin	25,363	Paul M. Reznick	33,059	Kent E. Baldauf, Jr.	36,082
William H. Logsdon	22,132	John W. McIlvaine	34,219	Christian E. Schuster	43,908
David C. Hanson	23,024	Blynn L. Shideler	35,034	Thomas Clinton	40,561
Frederick B. Ziesenheim	19,438	Julie W. Meder	36,216	Dean E. Geibel	42,570
Richard L. Byrne	28,498	Lester N. Fortney	38,141	Nathan J. Prepelka	43,016
Kent E. Baldauf	25,826	Randall A. Notzen	36,882	Kirk M. Miles	37,891
Barbara E. Johnson	31,198	James G. Porcelli	33,757	Jessica M. Sosenko	47,102
				Gary F. Matz	5,504

Send Correspondence to:
Russell D. Orkin, 700 Koppers Building, 436 Seventh Avenue, Pittsburgh PA 15219-1818

Direct Telephone calls to: *(name and telephone number)* **Russell D. Orkin (412) 471-8815**

Full name of sole or first inventor Steve CHICK
Inventor's signature Date 30/4/02
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Citizenship Australia
Post Office Address Unit 14, 122 Todman Avenue, Kensington, New South Wales, 2033, AUSTRALIA